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MAMMALS OF MARYLAND

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NORTH AMERICAN FAUNA

NUMBER 66

UNITED STATES
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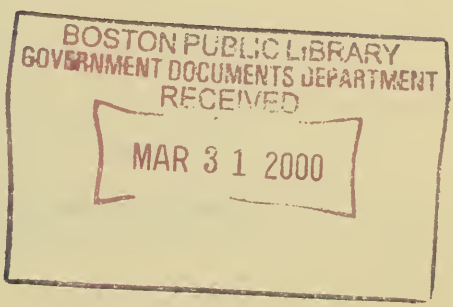
MAMMALS OF MARYLAND

By
John L. Paradiso

NUMBER 66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BUREAU OF SPORT FISHERIES AND WILDLIFE
John S. Gottschalk, *Director*

North American Fauna, Number 66

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INTRODUCTION

In 1950, Marshall C. Gardner (1950a, 1950b) began the first comprehensive listing of Maryland mammals, but he completed only the sections dealing with marsupials, insectivores, and bats. This has been the only statewide study of Maryland mammals ever undertaken, although a number of sectional accounts have appeared, including those by Goldman and Jackson (1939), Bures (1948), Hampe (1939), and Bailey (1923). In addition, Mansueti (1950) treated in detail the extinct and vanishing species of the State.

The present survey originated in the mid-1950's, but intensive work on it was not begun until 1962. During the course of the study, field work was conducted in all parts of the State except the Allegheny Mountain section. Specimens collected during this field work, and the large series of Maryland mammal specimens available in the national collections, form the basis for the present survey. In the "specimens examined" sections of the following accounts, the specimens are in the collections housed in the U.S. National Museum unless otherwise noted. Abbreviations used in the text for other institutions from which material has been examined are K.U. for Museum of Natural History, University of Kansas, U. Mich. for Museum of Zoology, University of Michigan, and U. Md. for University of Maryland. All measurements given in the accounts are in millimeters.

Several species are included in the body of the text for which there are as yet no valid records for the State. These have been indicated by placing the common names in parentheses. They are included because of the virtual certainty that they are a part of Maryland's mammal fauna. Of one of these species, a specimen was taken in West Virginia only a few feet from the Maryland state line; as for the others, Maryland contains abundant suitable habitat and they are known to occur both north and south of the State.

Distribution maps have been prepared for all land species except introduced forms and certain ones that have been restocked or are so widespread in distribution that they have been recorded from every county in the State. On the maps, crosshatched areas represent probable distribution, shaded symbols indicate specimens examined, unshaded symbols indicate published records or other reports that appear to be valid, and an unshaded symbol with a dot in the center indicates a type

locality. When more than one species or subspecies is represented on a single map, circles and triangles are used to distinguish them, and the crosshatchings representing their probable distributions run in different directions.

I want to express my thanks to Theodore A. Bookhout and Vagn Flyger of the University of Maryland's Natural Resources Institute for contributing a number of Maryland mammal records. I also want to acknowledge my gratitude to the late Romeo Mansueti of the Chesapeake Biological Laboratory, Solomons, Md., for his encouragement and advice on a number of distributional problems.

LOCATION AND AREA OF MARYLAND

Maryland lies between the parallels of 35° 53′ and 39° 44′ north latitude and the meridians 75° 4′ and 79° 29′ west longitude. It is bounded on the north by the State of Pennsylvania and on the east by the State of Delaware and the Atlantic Ocean. The southern boundary of the State is the Potomac River which separates it from Virginia and West Virginia. West Virginia also borders Maryland on the west. The District of Columbia is a political entity on the Potomac, between Prince Georges and Montgomery counties, Maryland. It is not physiographically distinct from Maryland in any way, and herein is regarded as a part of Maryland.

The Maryland Geological Survey lists the total area of the State as 12,300.21 square miles, of which 2,437 square miles are water. Thus the total land area of Maryland is 9,863.21 square miles, making the State the eighth smallest in the Union. The area of the District of Columbia is some 70 square miles, of which 8 are water.

Maryland extends in a general ESE–WNW direction for about 320 miles; the greatest north-south distance is approximately 150 miles. The State is actually a narrow cross section of the Coastal Plain, the Piedmont Plateau, and the Appalachian ridges. Elevations pass gradually from sea level to 3,342 feet on Backbone Mountain in Garrett County.

Geologically, Maryland varies greatly. Formations range from the most ancient granite and gneiss, through rocks of every age and great mineralogical diversity down to the coastal deposits of Recent times. Overlying these rock formations are a great diversity of soils. In contrast to its more northern neighbors, Maryland has never been glaciated.

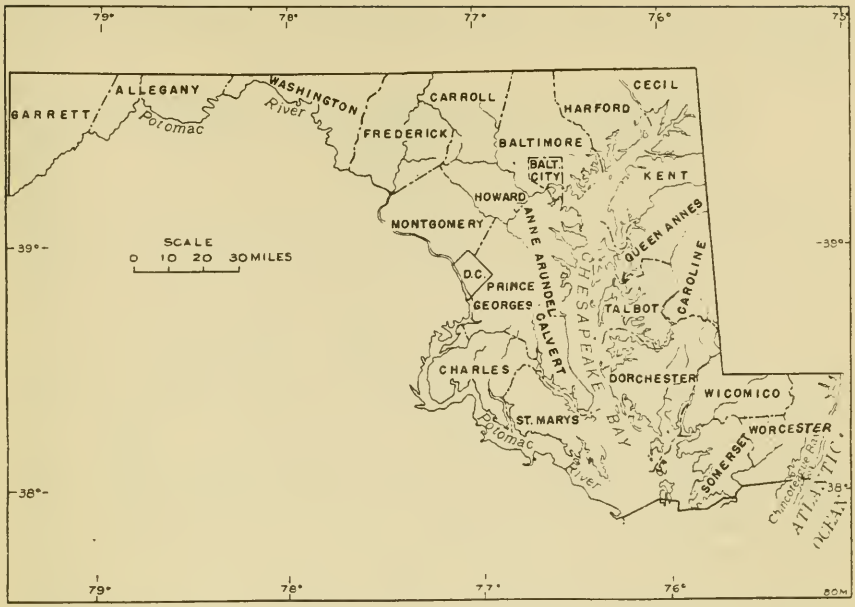

FIGURE 1.—Map of Maryland showing the 23 counties, Baltimore City, and the District of Columbia.

TEMPERATURE

The mean annual temperature for Maryland is 53 to 54 degrees. It varies from area to area, the greatest difference being between Worcester County on the Eastern Shore and Garrett County in the Allegheny Mountains: according to Shreve et al. (1910), the average annual temperature at Sunnyside in Garrett County is 47.1 degrees, whereas at Pocomoke City in Worcester County it is 58, a difference of 11 degrees. At intermediate points the average annual temperatures are also intermediate; the differences that exist are due to such factors as elevation and proximity to the ocean and Chesapeake Bay. The average date for the last killing frost in spring in western Maryland is the first week in May; farther east it is the last 10 days of April. In western Maryland the average time for the first killing frost in autumn is late September; in the eastern part of the State it is early November.

AVERAGE ANNUAL PRECIPITATION

Precipitation is distributed throughout the year, but with a somewhat greater amount in the warmer months than in the cold season. The heaviest rainfall, from 38 to 46 inches, occurs in western Maryland.

The Coastal Plain receives between 40 and 44 inches each year. Calvert County is one of the driest areas of the State and receives only about 36 inches yearly.

EFFECTS OF CIVILIZATION

Maryland, like most other eastern States, has no truly virgin areas. Even in the remotest regions of the western part of the State, logging has been conducted, and fields and pastures range well up onto the sides of the mountains. Some of the wildest parts of the State, until quite recently, were the marshes that lined both the eastern and the western sides of Chesapeake Bay and those along the Atlantic Ocean. With the expanding populations of both Washington and Baltimore seeking areas for summer recreation, many of these marshes are being drained and "improved" for human habitation. In addition, easy access is now available to the outer barrier beach on Assateague Island. The suburban communities of all the larger cities of the State are spreading farther and farther into the countryside and have eliminated some fine woods, swamps, and meadows. This is particularly true of Baltimore and Washington, the suburbs of which now extend 25 miles or more into the surrounding country. As a result, the site where the only specimen of the rare pigmy shrew, *Microsorex hoyi winnemana*, has ever been taken in Maryland is now part of a housing project, and the southeasternmost Coastal Plain locality for the southern bog lemming, *Synaptomys cooperi*, has met the same fate. Nevertheless, a number of areas remain in Maryland which are relatively isolated and which support a varied and abundant mammal fauna. Some species, such as the white-tailed deer and the cottontail rabbit, have actually profited by the changes man has brought to the State.

PRINCIPAL BIOTIC OR NATURAL AREAS IN MARYLAND

Maryland lies in 5 major physiographic provinces (Fenneman, 1938): Coastal Plain, Piedmont, Blue Ridge, Ridge and Valley, and Appalachian Plateaus.

There are three major forest regions (as described by Braun, 1950) in Maryland which correspond roughly to these physiographic provinces. They are the Oak-Pine Forest, the Oak-Chestnut Forest, and the Mixed Mesophytic Forest. Stewart and Robbins (1958) divide these major forest regions of Maryland into biotic or natural sections that represent areas showing floral or faunal differences of a secondary nature. They divide the Oak-Pine Forest region into an Eastern Shore section, an Upper Chesapeake Bay section, and a Western Shore sec-

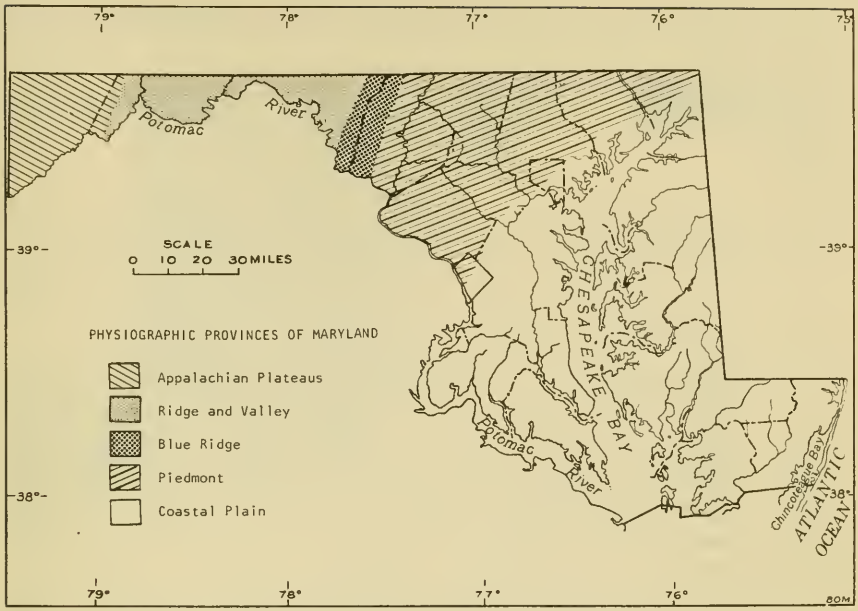

FIGURE 2.—Physiographic provinces of Maryland.

tion. The Oak-Chestnut Forest region is split into a Piedmont section and a Ridge and Valley section, while the Allegheny Mountain section comprises the Mixed Mesophytic Forest region in Maryland.

In general, mammal distribution in Maryland correlates well with these natural areas or sections, and reference is made to them throughout the text. An exception is that of the Upper Chesapeake Bay section (comprising the northern portion of the Eastern Shore, and the Coastal Plain of Baltimore and Harford counties) which seems to be too weakly differentiated as a biotic area from adjacent sections to have any relevance with regard to mammal distribution. This section has been deleted herein, the northern portion of the Eastern Shore being assigned to the Eastern Shore section, and the Coastal Plain of Baltimore and Harford counties being treated as part of the Western Shore section.

The following is primarily a condensation of Stewart and Robbins' description of Maryland's biotic sections.

Eastern Shore Section

The upland forests of this section are composed chiefly of loblolly pine (*Pinus taeda*) stands and oak-hickory forests or a mixture of the two. Along the tidal marshes, loblolly pine is found generally without deciduous associates. The Eastern Shore section is poorly drained and

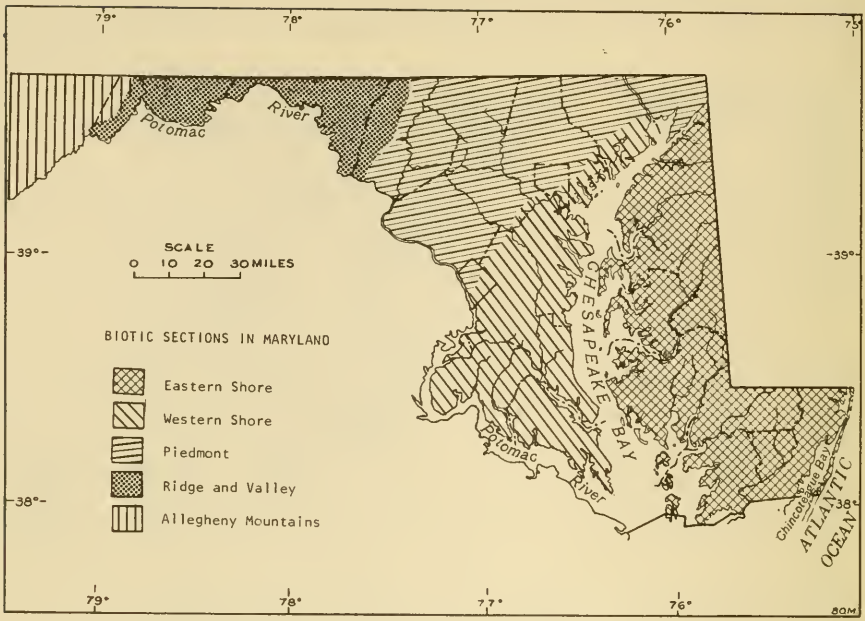

FIGURE 3.—Biotic sections of Maryland.

there are many upland and lowland swamps in which occur sweetgum (*Liquidambar styraciflua*), blackgum (*Nyssa slyvatica*), red maple (*Acer rubrum*), pin oak (*Quercus palustis*), and American holly (*Ilex opaca*). Along the Pocomoke River there are many plants with southern affinities such as bald cypress (*Tacodium distichum*), red bay (*Persea borbonia*), horse-sugar (*Symplocos tinctoria*), water oak (*Quercus nigra*), cross vine (*Bignonia capreolata*), and laurel-leaved greenbriar (*Smilax laurifolia*). In the northern part of this section the upland forests are almost entirely deciduous and of the oak-hickory type. In addition there are such habitats as barrier beaches, salt marshes, and brackish marshes. Elevation is under 100 feet, and the topography is flat.

Western Shore Section

The upland forests of the Western Shore section are composed of scrub pine (*Pinus virginiana*) stands, oak-hickory forests, or a mixture of the two. In the southern part loblolly pine is common, and in the sandy soil of the northern part pitch pine (*Pinus rigida*) frequently predominates. Rich moist upland forests of white oak (*Quercus alba*) and tulip poplar (*Liriodendron tulipifera*) occur locally throughout the section. Small seepage areas are frequent and usually support an upland swamp forest type that contains a well-

developed understory. Flood-plain forests are particularly luxuriant in the Western Shore section. Tidal marshes are commonly found around the numerous estuaries. Elevation is from 100 to 300 feet, and the topography is rolling.

Piedmont Section

The Piedmont section occupies the area of the Piedmont physiological province (Fenneman, 1938) and a small part of the Coastal Plain known as Elk Neck in Cecil County. The forests in this section consist mostly of white oak, black oak (*Quercus velutina*), tulip poplar, smoothbarked hickories (*Carya* sp.), and flowering dogwood (*Cornus florida*). In some areas chestnut oak (*Quercus prinus*) or scarlet oak (*Quercus coccinea*) is common, and occasionally stands of scrub pine or pitch pine are found. Beech (*Fagus grandifolia*) is often encountered on ravine slopes, and mixed mesophytic forest communities occur in some of the larger valleys with steep north slopes. These communities contain a mixture of central and northern hardwoods and sometimes hemlock (*Tsuga canadensis*). Elevations in this section range between 300 and 800 feet, and the topography is gently rolling. Much of the land has been cleared for farming.

Ridge and Valley Section

Chestnut oak is the common tree throughout most of the section, and in the higher elevations it is often found in nearly pure stands. In dry areas and on slopes with southern or western exposure there is scarlet oak, interspersed with occasional stands of scrub pine, pitch pine, or Table Mountain pine (*Pinus pungens*). Most of the ravines and steep northern slopes are occupied by mixed mesophytic forest communities in which the common species are hemlock, white pine (*Pinus strobus*), beech, sweet birch (*Betula lenta*), basswood (*Tilia americana*), sugar maple (*Acer saccharum*), tulip poplar, white oak, and northern red oak (*Quercus rubra*). On the valley floors, white oak, black oak, tulip poplar, and flowering dogwood communities occur. Groves of red cedar (*Juniperus virginiana*) are found in the limestone areas of the Hagerstown Valley. The section consists of a series of parallel ridges that range up to 2,000 feet in elevation.

Allegheny Mountain Section

This area is a high, undulating plateau, averaging about 2,500 feet above sea level. Several ridges, some 500 feet high, cross this plateau diagonally from northeast to southwest. The highest point in the State, Backbone Mountain (3,342 feet), is in this section. Hemlock

and white pine are occasionally encountered on the slopes and in the valleys, but deciduous trees predominate. These include sweet birch, sugar maple, red maple, black cherry (*Prunus serotina*), basswood, beech, shagbark hickory (*Carya ovata*), white oak, and northern red oak. On higher ridges, northern red oak and red maple predominate, with chestnut oaks, black oak, and yellow birch (*Betula lutea*) interspersed. Scattered red spruce (*Picea rubens*) is sometimes also found. In valleys above 2,400 feet, there are some relict bogs consisting of sedge meadows and bog heaths interspersed with patches of alder (*Alnus* sp.), great laurel (*Rhododendron maximum*), red spruce, hemlock, yellow birch, and red maple.

MARYLAND'S MAMMALIAN FAUNA

These biotic sections of Maryland are not sufficiently differentiated to support widely divergent mammalian populations. Some forms are confined to one or two sections of the State, but in general the mammalian fauna does not differ greatly from section to section. The average-fauna formula (Long, 1963) discussed below, reveals that the most significant division in the State is between the Piedmont section and the Ridge and Valley section. The most diversified mammalian fauna is in the Allegheny Mountain section, the most impoverished in the Eastern Shore section.

Long (1963, p. 139) recommends the average-fauna formula, $2C(100)/(N_1+N_2)$, for deriving a numerical expression of the faunal resemblance of one area to another (in this formula, C=number of kinds common to both faunas, N_1=number of kinds in smaller fauna, N_2=number of kinds in larger fauna). Using this formula, and substituting the number of species and subspecies for each section of Maryland, the following comparisons were obtained:

	Western Shore	Piedmont	Ridge and Valley	Allegheny Mountain
Eastern Shore	90	83	73	62
Western Shore		92	77	67
Piedmont			83	68
Ridge and Valley				87

These percentages show, as is to be expected in an area of this small size, that the mammal fauna of all the sections of Maryland rather closely resemble one another. Naturally, the most distant sections of the State geographically and ecologically, the Allegheny Mountain and the Eastern Shore, differ the most faunistically. Nevertheless 75 percent of the species and subspecies are common to both sections. The

closest resemblance between two sections is that between the Western Shore and the Piedmont. Surprisingly, the two Coastal Plain sections, the Western Shore and the Eastern Shore, show slightly less resemblance to each other. This is probably due to the isolating effect of the Chesapeake Bay on the Eastern Shore.

The percentages show clearly that the Allegheny Mountain and Ridge and Valley sections have close faunal resemblance, and that as a unit they stand somewhat apart from the three eastern sections. Thus, while the resemblance ratio of the Eastern Shore to the Western Shore is 90 percent, and that of the Western Shore to the Piedmont is 92 percent, the Piedmont has a resemblance to the neighboring Ridge and Valley section of only 83 percent. The resemblance of the Ridge and Valley to its neighboring Allegheny Mountain section returns to 87 percent, indicating that these two sections differ to some extent from the three eastern sections, which in turn appear to form a closely allied mammalian fauna unit. Therefore, the most strongly marked division with regard to mammal distribution in Maryland is that between the gently rolling Piedmont of Montgomery, Howard, Baltimore, Harford, Carroll, and eastern Frederick Counties and the upland Blue Ridge Mountains (Ridge and Valley section) to the west in Washington and western Frederick Counties.

Taken as a whole, Maryland's mammal fauna seems to be more northern than southern in origin. Only a few distinctly southern species (represented usually by small numbers of individuals) reach Maryland. Some of these are *Reithrodontomys humulis*, *Sorex longirostris*, and *Spilogale putorius*. On the other hand, a number of distinctly northern species reach south to Maryland (*Sorex cinereus*, *Mustela erminea*, *Lepus americanus*, *Tamiasciurus hudsonicus*, and a number of others) and extend even farther south, particularly in the Appalachian Mountains, where many of them range as far south as North Carolina and Tennessee.

KEYS

The following keys employ external and easily observable or measurable characters when possible. In a few instances it has been necessary to resort to dental characters when external ones were not sufficiently marked to separate forms. The keys are designed for use on adult animals only.

Key to the Orders of Maryland Land Mammals

1*a*. Forelimbs modified as wings ..... *Chiroptera* (bats)
b. Forelimbs not modified as wings 2
2*a*. Feet provided with hoofs ..... *Artiodactyla* (even-toed hoofed mammals)
b. Feet provided with claws 3

3*a*. Canine teeth absent; incisors chisel-like 4
b. Canine teeth present; incisors not chisel-like 5
4*a*. Upper incisors 2–2 ..... *Lagomorpha* (rabbits, hares, etc.)
b. Upper incisors 1–1 ..... *Rodentia* (gnawing mammals)
5*a*. Canine teeth similar in appearance to other teeth; eyes inconspicuous ..... *Insectivora* (moles, shrews, etc.)
b. Canine teeth well developed; eyes not rudimentary 6
6*a*. Tail prehensile; first digit on fore and hind limbs opposable; abdominal pouch present in female ..... *Marsupialia* (pouched mammals)
b. Tail not prehensile; first digit not opposable; no abdominal pouch present ..... *Carnivora* (flesh eating mammals)

Key to the Order Insectivora in Maryland

1*a*. Forefeet greatly enlarged and adapted for digging 9
b. Forefeet similar in size to hind feet and not adapted for digging 2
2*a*. Tail short, less than 25 percent of total length of animal 3
b. Tail long, more than 30 percent of total length of animal 4
3*a*. Coloration grayish; size more than 100 mm.; 32 teeth in mouth *Blarina brevicauda* (short-tailed shrew)
b. Coloration brownish; size small, less than 100 mm.; 30 teeth in mouth *Cryptotis parva* (least shrew)
4*a*. Third and fifth upper unicuspid teeth minute so that only three of the five upper unicuspids are visible when skull is viewed laterally *Microsorex hoyi* (pigmy shrew)
b. Only fifth unicuspid tooth in upper jaw minute so that four unicuspids are visible when skull is viewed laterally 5
5*a*. Total length 145 mm. or more; hind feet large and fringed with stiff hairs; third and fourth toes of hind feet thinly webbed for about half their length ..... *Sorex palustris* (water shrew)
b. Total length 135 mm. or less; hind feet not conspicuously large and not fringed with stiff hairs; no webbing on any toes 6
6*a*. Tail more than 55 mm. in length; coloration uniform dark gray throughout ..... *Sorex dispar* (long-tailed shrew)
b. Tail less than 55 mm. in total length; coloration not uniformly dark gray 7
7*a*. Total length greater than 110 mm ..... *Sorex fumeus* (smoky shrew)
b. Total length under 100 mm 8
8*a*. Coloration reddish brown ..... *Sorex longirostris* (southeastern shrew)
b. Coloration dull brown or grayish brown ..... *Sorex cinereus* (masked shrew)
9*a*. Snout fringed with fleshy projections; tail long, more than 50 mm. in length ..... *Condylura cristata* (star-nosed mole)
b. Snout not fringed with fleshy projections; tail less than 40 mm. in length 10
10*a*. Tail thin, flesh-colored and scantily haired *Scalopus aquaticus* (eastern mole)
b. Tail thick, blackish and well haired *Parascalops breweri* (hairy-tailed mole)

Key to the Order Chiroptera in Maryland

1*a*. Interfemoral membrane wholly or partially furred on upper surface 2
b. Interfemoral membrane not furred on upper surface 4

2*a*. Coloration reddish-orange ..... *Lasiurus borealis* (red bat)
b. Coloration brownish to black, frosted with white 3
3*a*. Total length greater than 125 mm.; interfemoral membrane wholly furred; coloration brownish, heavily frosted with white; individual hairs banded ..... *Lasiurus cinereus* (hoary bat)
b. Total length less than 120mm.; interfemoral membrane only partially furred; coloration blackish, lightly frosted with white; individual hairs not banded ..... *Lasionycteris noctivagans* (silver-haired bat)
4*a*. Ears reaching considerably beyond end of nose when laid forward 5
b. Ears not reaching noticeably beyond end of nose when laid forward 6
5*a*. Ears greatly enlarged, over 35 mm. from crown in length *Plecotus townsendii* (big-eared bat)
b. Ears not noticeably enlarged ..... *Myotis keenii* (Keen myotis)
6*a*. Over 100 mm. in total length ..... *Eptesicus fuscus* (big brown bat)
b. Under 100 mm. in total length 7
7*a*. Under 85 mm. in total length; distinct black facial mask *Myotis subulatus* (small-footed myotis)
b. Over 85 mm. in total length; no black facial mask 8
8*a*. Pale golden brown in coloration; nose, ears, and wings reddish-brown *Pipistrellus subflavus* (eastern pipistrelle)
b. Coloration dark brown; ears, nose, and wings nearly black 9
9*a*. Fur long, thick, and shiny ..... *Myotis lucifugus* (little brown bat)
b. Fur short, dull and sparse 10
10*a*. Coloration dark brown; ears thick and leathery *Nycticeius humeralis* (evening bat)
b. Coloration pinkish brown; ears not thick and leathery *Myotis sodalis* (Indiana myotis)

Key to the Order Lagomorpha in Maryland

1*a*. Length of hind foot greater than 115 mm (as much as 150 mm. in some specimens); coloration white in winter *Lepus americanus* (showshoe rabbit)
b. Length of hind foot less than 115 mm.; coloration brownish in all seasons 2
2*a*. Black on forward edge of ear sharply defined from brown of rest of ear; distinct black patch between ears *Sylvilagus transitionalis* (New England cottontail)
b. Black on forward edge of ear not sharply defined; no dark patch between ears ..... *Sylvilagus floridanus* (eastern cottontail)

Key to the Order Rodentia in Maryland

1*a*. Upper incisors with longitudinal grooves 2
b. Upper incisors without longitudinal grooves 5
2*a*. Tail very short, equal to about one-sixth of total length *Synaptomys cooperi* (southern bog lemming)
b. Tail longer than one-sixth of total length 3
3*a*. Tail less than one-half of total length *Reithrodontomys humulis* (harvest mouse)
b. Tail greater than one-half of total length 4

4*a*. Coloration of sides orange; tail often tipped with white
Napaeozapus insignis (woodland jumping mouse)
b. Coloration of sides yellowish; tail never tipped with white
Zapus hudsonius (meadow jumping mouse)

5*a*. Tail bushy 6
b. Tail not bushy 10

6*a*. Fore and hind limbs connected by a loose fold of skin; adapting the animal for gliding ..... *Glaucomys volans* (southern flying squirrel)
b. Fore and hind limbs not connected by a loose fold of skin 7

7*a*. Tail less than one-quarter of the total length .. *Marmota monax* (woodchuck)
b. Tail greater than one-third of the total length 8

8*a*. Coloration reddish-brown above; under 325 mm. in total length
Tamiasciurus hudsonicus (red squirrel)
b. Coloration not reddish-brown; over 325 mm. in total length 9

9*a*. Coloration of upper parts gray, darker along middle of back; under 550 mm. in total length; upper premolars 2–2
Sciurus carolinensis (gray squirrel)
b. Coloration of upper parts variable-grayish, reddish, or buffy, but sides not noticeably paler than back; over 550 mm. in total length; upper premolars 1–1 ..... *Sciurus niger* (fox squirrel)

10*a*. Coloration on back reddish, marked with several longitudinal black and white stripes ..... *Tamias striatus* (eastern chipmunk)
b. Back not striped 11

11*a*. Tail flattened horizontally, paddle-like ..... *Castor canadensis* (beaver)
b. Tail not horizontally flattened 12

12*a*. Tail compressed laterally ..... *Ondatra zibethicus* (muskrat)
b. Tail not compressed laterally 13

13*a*. Total length over 325 mm 14
b. Total length less than 275 mm 17

14*a*. Total length over 500 mm.; aquatic in habits .. *Myocastor coypus* (nutria)
b. Total length less than 500 mm 15

15*a*. Tail length equal to, or more than, half total length of animal
Rattus rattus (black rat)
b. Tail length less than half total length 16

16*a*. Tail well haired, and not conspicuously scaly
Neotoma floridana (eastern woodrat)
b. Tail scantily haired and noticeably scaly . *Rattus norvegicus* (Norway rat)

17*a*. Tail very short, equal to about one-sixth of total length
Pitymys pinetorum (pine vole)
b. Tail longer than one-sixth of total length 18

18*a*. Tail only moderately short, equal to about one-third of the total length .. 19
b. Tail longer than one-third of total length 20

19*a*. Back marked with a wide band of dull red from forehead to rump
Clethrionomys gapperi (red-backed vole)
b. Back dark brown to nearly black .. *Microtus pennsylvanicus* (meadow vole)

20*a*. Line of demarcation between coloration of back and abdomen indistinct; coloration often uniform gray throughout .. *Mus musculus* (house mouse)
b. Sharp line of demarcation between coloration of back and abdomen; abdomen always white 21

21*a*. Total length over 225 mm ..... *Oryzomys palustris* (rice rat)
b. Total length under 200 mm 22

22*a*. Coloration on back chestnut brown
Peromyscus leucopus (white-footed mouse)
b. Coloration on back grayish brown.. *Peromyscus maniculatus* (deer mouse)

Key to the Order Carnivora in Maryland

1*a*. Coloration black, or black and white 2
b. Coloration not black 4
2*a*. Size large, over 1,200 mm. in total length; tail short and not bushy
Euarctos americanus (black bear)
b. Under 800 mm. in total length; tail long and bushy 3
3*a*. Upper parts marked with no more than two white stripes
Mephitis mephitis (striped skunk)
b. Upper parts marked with four or more white stripes
Spilogale putorius (spotted skunk)
4*a*. Black facial mask; tail ringed ..... *Procyon lotor* (raccoon)
b. No black facial mask; tail not ringed 5
5*a*. Total length under 700 mm 6
b. Total length over 900 mm 9
6*a*. Underparts brown except for white spots on chin and throat
Mustela vison (mink)
b. Underparts whitish or yellowish 7
7*a*. No black tail tip; tail less than one-quarter of total length
Mustela nivalis (least weasel)
b. Black tail tip; tail more than one-quarter of total length 8
8*a*. Black tail tip nearly 50 percent of tail vertebrae length
Mustela erminea (ermine)
b. Black tail tip 40 percent or less of tail vertebrae length
Mustela frenata (long-tailed weasel)
9*a*. Claws retractile; pupils of eyes elliptical; tail short, less than 165 mm
Lynx rufus (bobcat)
b. Claws not retractile; pupils of eyes not elliptical; tail long, over 300 mm 10
10*a*. Toes of fore and hind feet webbed; tail thick and heavy; aquatic in habits ..... *Lutra canadensis* (otter)
b. Toes not webbed; tail not thick and heavy; not aquatic in habits 11
11*a*. Coloration reddish; tail tip white ..... *Vulpes vulpes* (red fox)
b. Coloration grizzled grayish; no white tail tip 12
12*a*. Total length over 1,050 mm ..... *Canis latrans* (coyote)
b. Total length under 1,050 mm ..... *Urocyon cinereoargenteus* (gray fox)

Key to the Order Artiodactyla in Maryland

1*a*. Back brownish, or reddish-olive in coloration, speckled with indistinct white blotches; antlers narrow and standing erect above head; small canine teeth in upper jaws ..... *Cervus nippon* (Sika deer)
b. Back reddish-brown (summer) or grayish (winter) in coloration, not speckled; antlers heavy, and curving forward over head; no canine teeth present in upper jaws ..... *Odocoileus virginianus* (Virginia deer)

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ACCOUNTS OF SPECIES

Order MARSUPIALIA (pouched mammals)

Family DIDELPHIDAE (opossums)

OPOSSUM

Didelphis marsupialis virginiana Kerr

Didelphis virginiana Kerr, The animal kingdom . . ., p. 193, 1792.

Type locality.—Virginia.

General distribution.—In the eastern United States from Vermont, New York, central Michigan, Wisconsin, and Minnesota, south to central Georgia, Alabama, Mississippi, Louisiana, and Texas.

Distribution in Maryland.—Occurs abundantly in all sections of the State.

Distinguishing characteristics.—Teeth 5/4, 1/1, 3/3, 4/4, = 50; tail naked and prehensile; five toes on each foot, the first on each hind foot clawless and thumblike; outer hair long and coarse, underfur short and soft; general coloration grizzled-grayish.

Measurements.—Three adults from Cabin John, Montgomery County, measure: Total length 780, 737, 795; tail vertebrae 298, 325, 333; hind foot 70, 63, 70; greatest length of skull 117.7, 98.6, 111; zygomatic breadth 63.5, 53.5, 54.7.

Habitat and habits.—The opossum prefers densely forested areas. Llewellyn and Dale (1964, pp. 120–121) found that at the Patuxent Research Center, near Laurel, Prince Georges County, this species was primarily an animal of the low, dense woodland, favoring sections near water. They found that well-drained upland woods were less desirable, and the open cleared or cultivated lands seemed to be of slight value for the opossum. Nevertheless, it will frequently wander into meadows and cultivated fields in search of food. The prehensile tail and opposable first toe on the hind foot make this animal almost as much at home in trees as on the ground.

The opossum apparently does not favor the pine woods and salt marshes along the Atlantic coast. One specimen was taken on the Virginia portion of Assateague Island in the early 1930's, but local residents report that none have been seen there in a number of years.

The species is abundant in the Rock Creek Park area of the District of Columbia, often wandering into nearby regions of the city at night, searching for food and sometimes rummaging in garbage pails in residential areas considerably distant from the wooded areas. One such wanderer recently made his abode in the backyard of a row-house near the center of the city where he remained for many weeks,

visiting a nearby porch in the evenings to eat the pet food set out by the owner for her cat.

The opossum is a marsupial, distantly related to such animals as the kangaroo and the koala of Australia. It gives birth to live young, but the young are born in a premature condition and are nursed in the pouch or marsupium of the mother. When born, they are naked or grublike in appearance, but the forelimbs are well enough developed to be used for crawling into the pouch. Development is rapid in the pouch, and within 4 to 5 weeks the young are ready to leave for short periods. Llewellyn and Dale (1964, pp. 118–121) found that in Maryland the opossum begins to breed in early February, and young are found in the pouch until August. Hartman (1952, p. 73) estimates the gestation period as slightly under 13 days. Evidently two litters are produced during a breeding season, but the first litter accounts for the majority of young. Llewellyn and Dale found that the average number of young for 57 litters in pouch was 7.74.

The opossum makes its home in almost any shelter where it can be dry and safe from enemies. This may be under sheds or buildings, in brush piles, or in holes in trees. In its eating habits the opossum is as unselective as it is in finding a shelter. Hartman (1952, p. 62) lists the frequency of foods taken in the following order: insects, fruits, invertebrates (other than insects), mammals, reptiles, grains, birds, and eggs. It also eats carrion.

Specimens examined.—Montgomery County: Bethesda, 2; Boyds, 1; Cabin John, 3; Plummers Island, 2; no exact locality, 2. *Prince Georges County:* Beltsville, 2; Bladensburg, 1; Branchville, 4; Greenbelt, 2; Laurel, 36; Patuxent Research Center, 2; T.B., 1. *District of Columbia:* 25.

Other records and reports.—Opossums have been killed in every Maryland county (LeCompte, 1942).

Remarks.—As noted by Gardner (1950, p. 65), Maryland opossums are indistinguishable from Virginia topotypes of *virginiana.*

Order INSECTIVORA (shrews, moles, etc.)

Family SORICIDAE (shrews)

MASKED SHREW

Sorex cinereus Kerr

This species closely resembles the southeastern shrew (*Sorex longirostris*) and the pigmy shrew (*Microsorex hoyi*). The differences between the masked shrew and these other species are discussed under the species accounts of the other two.

There are two subspecies of *Sorex cinereus* in Maryland. These are:

Sorex cinereus cinereus Kerr

Sorex arcticus cinereus Kerr, The animal kingdom . . ., p. 206, 1792.

Type locality.—Fort Severn, Ontario, Canada.

General distribution.—This is a wide-ranging subspecies, distributed over much of the northern part of North America. In the eastern United States it ranges throughout New England, New York, and western Pennsylvania, and south in the Appalachian Mountains to North Carolina.

Distribution in Maryland.—Ridge and Valley, and Allegheny Mountain sections. (See fig. 4.)

Distinguishing characteristics.—Teeth 3/1, 1/1, 3/1, 3/3, = 32; third unicuspid usually larger than, or equal in size to, fourth unicuspid; size very small; snout elongated and pointed; tail long, slightly less than half the total length of the animal; ears short and hidden in fur; coloration in winter pelage dark brown to almost black on upper parts, lighter brown or grayish on underparts; in summer, coloration is somewhat lighter and more brownish.

Measurements.—An adult female from 9 miles east of Oldtown, Allegany County, measures: Total length 88; tail 40; hind foot 11; ear 7; condylobasal length of skull 15.7; cranial breadth 7.4; interorbital breadth 2.3; maxillary breadth 3.9; crown length of upper toothrow (exclusive of first incisors) 5.4.

Habitat and habits.—This shrew is most common around rocks in moist or damp coniferous or deciduous woods. Sometimes it lives in grassy bogs and swamps, but rarely if ever in dry fields or woods

The nest is located on or near the surface of the ground, in a cavity under a log, rock, or other object. It is composed mainly of leaves, and in shape resembles a flattened sphere some 3 inches in diameter. In its ramblings this shrew utilizes surface runways that it constructs itself and subterranean runways that have been dug by mice.

The masked shrew is a voracious eater and consumes a wide variety of foods. These include beetles, moths, caterpillars, bugs, flies, crickets, spiders, worms, and the flesh of mice and other shrews. It also eats some vegetable matter such as moss and seeds.

Little is known of the breeding habits of the masked shrew. The breeding season may extend from March to September, and as many as three litters may be produced in a single season. The gestation period is probably about 18 days, and from 4 to 10 young are produced per litter, the usual number being 7. The male stays with the female before and after pregnancy and during the early development of the young. A young shrew is able to shift for itself within 20 to 25 days after its birth.

The shrew is physically strong for its size, but being extremely active it seems to burn itself out at an early age. Its longevity is probably not over 2 years if it is allowed to live its full life span.

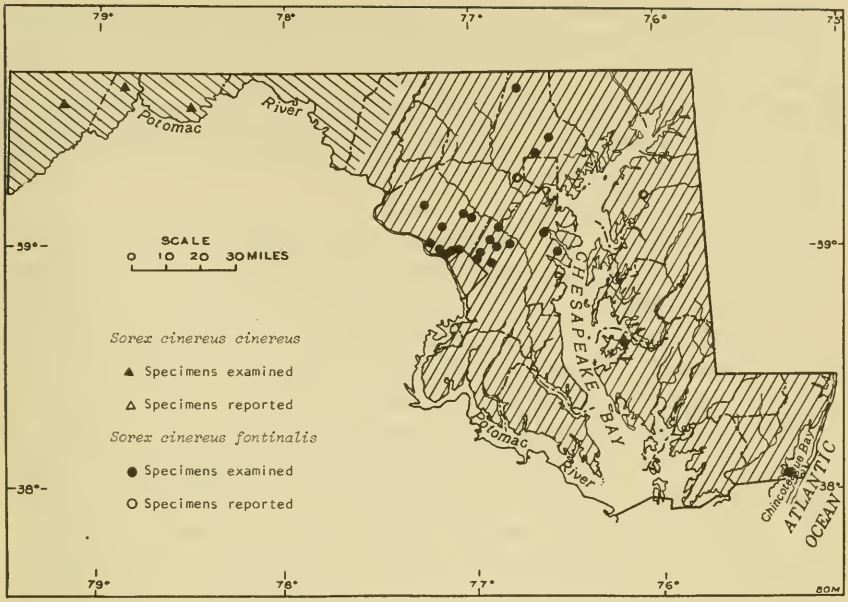

FIGURE 4.—Distribution of *Sorex cinereus fontinalis* and *S. c. cinereus*.

Specimens examined.—Allegany County: Mount Savage, 1; Oldtown, 3 miles E, 1; Oldtown, 9 miles E, 1. *Garrett County:* Bittinger, 2; Cunningham Swamp, 4 (Coll. U. Md.).

Sorex cinereus fontinalis Hollister

Sorex fontinalis Hollister, Proc. U.S. National Museum, 40: 378, 17 April 1911.

Type locality.—Cold Spring Swamp, near Beltsville, Prince Georges County, Maryland.

General distribution.—Piedmont and Coastal Plain of Pennsylvania, Maryland, and northern Virginia.

Distribution in Maryland.—Piedmont, Western Shore, and Eastern Shore sections.

The characters of this race seem to be best developed in the lower Piedmont section near Washington, D.C. (near the type locality). Specimens from the Coastal Plain sections of the Eastern Shore and upper Western Shore are less typical and apparently represent intergrades with *S. c. cinereus*, which is distributed to the northeast in New Jersey. In the upper Piedmont the subspecies intergrades with *S. c. cinereus*. No specimens of masked shrew have been taken in the southern part of the Western Shore section (Calvert, St. Marys, and Charles Counties) and perhaps the species does not range this far south in the State.

Distinguishing characteristics.—This subspecies is very similar to *S. c. cinereus* and differs from it only in minor details which are most evident on the skull. Externally, the only apparent differences are somewhat smaller size and shorter tail. The skull is smaller, with a narrower braincase and a shorter, relatively wider rostrum. The unicuspid toothrow is shorter than in *S. c. cinereus*, and the teeth in the unicuspid row are more crowded.

This subspecies of masked shrew closely resembles the southeastern shrew (*Sorex longirostris*), which in the eastern United States reaches the northern limits of its range in Maryland. Differences between the two are discussed under the species account for *Sorex longirostris*.

Measurements.—External measurements of eight adults from the vicinity of Rockville, Montgomery County, are as follows: Total length 81.7 (76–89); tail vertebrae 33.7 (30–35); hind foot 10.6 (10–11). Cranial measurements of five adults from the vicinity of Rockville are: Condylobasal length 14.9 (14.7–15.2); cranial breadth 7.0 (6.7–7.1); least interorbital breadth 2.7 (2.6–2.8); maxillary breadth 4.1 (4.0–4.2); crown length of upper toothrow (exclusive of first incisors) 5.5 (5.3–5.7).

Habitat and habits.—Bures (1948, p. 62) collected 14 masked shrews (which he incorrectly believed to be *Sorex longirostris*) near Lake Roland, Baltimore County. He says that, with two exceptions, all of these shrews were taken in a mixed deciduous woods bordering a railroad siding. Of the two exceptions, one was trapped in a dense tangle of sumac and honeysuckle bordering a marsh, and the other in similar habitat along a small stream paralleling Falls Road. He states that systematic trapping throughout the area confirmed his opinion that this shrew does not wander far from deciduous woods. Hampe (1939, p. 5), however, trapped this shrew in the Patapsco State Park in the marshy pastures near Glenartney, and the type specimen of the subspecies was collected in a cold spring swamp in Prince Georges County.

This shrew apparently does not occur on the outer barrier beaches of the Atlantic Coast. Many weeks of trapping there failed to produce a single specimen. It does inhabit the adjacent mainland, and the skull of one was found in an owl pellet on Mills Island in Chincoteague Bay, Worcester County. The shrew had undoubtedly been captured by the owl on the nearby mainland.

Regarding the nesting habits and young of this species, Hampe (1936) writes that he examined the nest of one which was under a discarded trash-filled box among the leaves about 6 feet from the road between Glenartney and Vineyard, Baltimore County. It was composed of a small bundle of dried and broken leaves loosely packed in a small depression in the ground. It was fairly dry, but the surrounding ground was very damp. This nest was found on 18 October 1936

and contained six blind and hairless young. At the time of this discovery the young were probably a week old, and one of them measured 43 mm. in total length with tail and hind foot measurements of 12 and 6 mm. respectively. The nest was visited again in about 2 weeks, and the young had developed to a size of 77 mm. in total length with tail and hind foot measurements of 33 and 10 mm. They were well furred and quite active. When the nest was visited for the final time on 8 November, only 3 young could be found, and they quickly scampered away into the surrounding brush. The mother was seen in the nest only when it was first investigated on 18 October, and she scurried away very rapidly when the nest was opened.

With regard to feeding and breeding habits of this race not much is known, but they probably are similar to those of *Sorex c. cinereus*. As with *cinereus*, this subspecies appears to be cyclical as far as abundance in particular areas is concerned; some years they are scarce, in others numerous. An example of how abundant these shrews may be in some years is provided by Kyle Barbehenn who collected 60 of them near Germantown, Montgomery County, between November 1958 and January 1959, and more than 150 near Rockville, Montgomery County, from February to April 1959.

Specimens examined.—Anne Arundel County: Annapolis, 3 miles NW, 1; Severn Run, 1. *Baltimore County:* Lake Roland, 11; Lock Raven, 5; Pretty Boy Reservoir (near Middletown), 1. *Dorchester County:* Cambridge, 1. *Montgomery County:* Ashton, 1; Bethesda, 1; Cabin John, 1; Chevy Chase, 1; Germantown, 60; Glen Echo Heights, 1; Great Falls, 1; Rockville (near), 153; Sandy Spring, 1. *Prince Georges County:* Beltsville, 1; Bowie, 1; Hollywood, 1; Hyattsville, 5; Landover, 1; Laurel, 3; Patuxent Wildlife Research Center, 3; Tuxedo, 1. *Worcester County:* Mills Island, 1 (from owl pellet).

Other records and reports.—Kent County: Chestertown (U.S. Fish and Wildlife Service files). *Baltimore County:* Patapsco State Park (Hampe, 1936).

Remarks.—This shrew was for many years considered a distinct species. Poole (1937, p. 96), however, showed that in Pennsylvania there is an unbroken gradation between this form and *Sorex cinereus* and that the two are only subspecifically separable. In Maryland, the most typical specimens of *fontinalis* are found in the vicinity of the type locality. Farther to the northwest, near Rockville and Germantown, Montgomery County, specimens, although still referable to *fontinalis*, are somewhat larger than typical of the race, and are approaching *cinereus*. The real dividing line for the 2 subspecies in Maryland is that between the Piedmont and the Ridge and Valley sections, those to the west being referable to *cinereus*, those to the east to *fontinalis*. Specimens from north of Baltimore and from the Eastern Shore sec-

tion also appear to be intergrading with *S. c. cinereus*. *S. c. fontinalis* appears to represent the end of a cline with regard to small size, shortening of the rostrum, crowding of the unicuspid toothrow, and short tail.

Maryland represents the southern terminus for the distribution of the species *Sorex cinereus* east of the Appalachian Mountains.

SOUTHEASTERN SHREW

Sorex longirostris longirostris Bachman

Sorex longirostris Bachman, Journal Acad. Nat. Science, Philadelphia, ser. 1, 7 (2) : 370, 1837.

Type locality.—Hume Plantations, swamps of the Santee River (= Cat Island, mouth of Santee River), South Carolina.

General distribution.—The southeastern United States from southern Maryland and the District of Columbia to central Florida, and westward, around the southern end of the Appalachian Mountains to Kentucky, central Indiana, and Illinois.

Distribution in Maryland.—The southern portion of the Western Shore section, and perhaps extending into the lower Piedmont section. Maryland is the northernmost limit of the distribution of the species in the eastern United States.

Distinguishing characteristics.—This shrew may be easily confused with *Sorex cinereus*, particularly the race *fontinalis*, and with *Microsorex hoyi*. It is distinguished from *Sorex cinereus* by the following: size smaller; tail shorter; coloration more reddish in winter pelage; feet smaller; rostrum shorter and blunter; unicuspid toothrow more crowded; and a greater tendency for the fourth unicuspid to exceed the third in size. From *Microsorex hoyi* it differs in a major dental character. In *Microsorex* the third upper unicuspid is minute and disk-like, and not visible when the jaw is seen in side view. The fifth unicuspid is also minute and not visible in side view, so that only 3 unicuspids are visible laterally in the upper jaw, the first, second, and fourth. In *Sorex longirostris* (and *Sorex cinereus*) 4 or 5 unicuspids are always visible when the skull is viewed laterally. In addition, *Sorex longirostris* is somewhat larger, more reddish in coloration, and has a longer tail than *Microsorex hoyi*.

Measurements.—One specimen from Chesapeake Beach, Calvert County, has the following cranial measurements: Condylobasal length 14.3; cranial breadth 6.6; least interorbital breadth 2.9; maxillary breadth 4.1; crown length of upper toothrow (exclusive of first incisor) 5.1.

Three specimens from Raleigh, N.C., average 82.6 mm. in total length and have an average tail length of 30.2 mm.

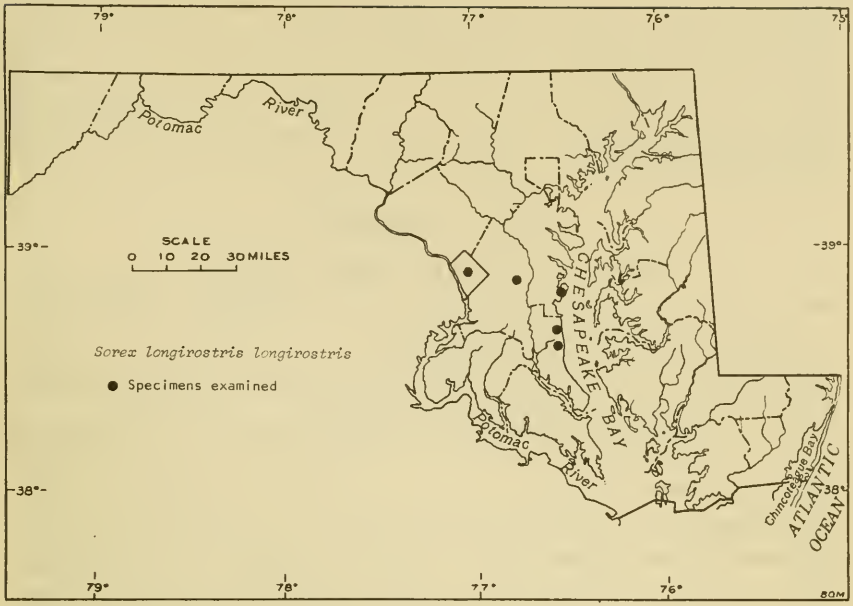

FIGURE 5.—Distribution of *Sorex longirostris longirostris.*

Habitat and habits.—Although this shrew prefers moist situations such as bogs and damp woods, it has on occasion been taken on comparatively high ground. It is a rare species, and little is known of its habits, although they probably do not differ much from those of *S. cinereus.* An interesting sidelight on the specimen from Chesapeake Beach, Calvert County, is a notation on the original label that says "fell over cliffs to bayshore."

Specimens examined.—Anne Arundel County: Shadyside, 1. *Calvert County:* Camp Roosevelt, 2; Chesapeake Beach, 1. *Prince Georges County:* Hall, 1. District of Columbia: 1.

Remarks.—It is interesting to note that, in the eastern United States at least, the ranges of *Sorex cinereus* and *Sorex longirostris* do not at present seem to overlap anywhere. North of a certain line (in Maryland this line lies in the Western Shore section between Washington, D.C., and Shadyside, Anne Arundel County) all specimens collected have been *S. cinereus*, whereas south of this line *S. longirostris* only has been taken. There does not appear, however, to be any evidence of intergradation between the species. Specimens of *S. longirostris* from Calvert and Anne Arundel Counties, Md., are just as typical of that species as are those from farther south in North and South Carolina, whereas specimens from Rockville, only a few miles away, are clearly *S. cinereus.* That the two are distinct species is further demonstrated

by the fact that both have been taken in the same field in central Indiana.

In all probability *Sorex cinereus* will eventually be found to be a resident of the southern portion of the Western Shore section, and *S. longirostris* may be distributed through more of the Piedmont and northern Western Shore section than is currently indicated.

(WATER SHREW)

Sorex palustris punctulatus Hooper

Sorex palustris punctulatus Hooper, Occas. Papers Mus. Zool. Univ. Mich., 463: 1, 15 September 1942.

Type locality.—West Virginia, Randolph County, 6 miles northwest of Durbin, Shavers Fork of the Cheat River, 3,600 feet elevation.

General distribution.—"Allegheny Mountains of eastern West Virginia, and probably also of southwestern Pennsylvania, western Maryland, and northwestern Virginia." (Hooper, 1942, p. 1).

Distribution in Maryland.—Not recorded for the State, but undoubtedly occurs in the higher elevations of the Allegheny Mountain section.

Distinguishing characteristics.—Largest of all the eastern long-tailed shrews; hind feet large, and with a fringe of stiff hairs; third and fourth hind toes joined by thin web at the base for slightly more than half their length; grizzled coloration on upper parts, and pale gray underparts in winter pelage; tail markedly bicolored. Tooth formula as in *Sorex cinereus*, but third unicuspid smaller than fourth. This is an amphibious species, well adapted for an aquatic life.

Measurements.—Hooper (1942) gives some measurements of the type and two paratypes (from Randolph and Preston Counties, W. Va.) as follows: Total length 152, 153, 155; tail 64, 70, 71; hind foot 19, 20, 20; condylobasal length of skull 21.1, 21.2,——, cranial breadth 10.6, 10.3,——; interorbital breadth 3.9, 3.8, 3.9; maxillary breadth 6.5, 6.4, 6.5; maxillary toothrow 7.9, 8.0, 8.1.

Habitat and habits.—This species prefers very wet areas along the borders of streams, lakes, and ponds. Often it is found in marshes and bogs, and in beaver and muskrat houses, particularly in winter. It favors heavily wooded areas and is rarely found in marshes that are devoid of bushes or trees. According to Hooper (1942), the type specimen of the subspecies *punctulatus* was collected under a log at the base of a yellow birch sapling, in a forest of spruce, hemlock, yellow birch, maple, and beech, about 100 yards from Shavers Fork, the nearest body of water. The paratypes were taken at the edge of streams feeding or draining spruce swamps, one specimen among bracken, rhododendron, and hemlock, the other among sedges, rushes, willow, and spruce. There are many areas similar to this in Garret County

which the water shrew may inhabit, and one of the specimens mentioned by Hooper was taken one mile south-southeast of Cranesville, Preston County, W. Va., at an altitude of 2,600 feet, only a few yards from the Maryland State line.

This shrew does not hibernate and is active all winter. It is primarily nocturnal in habits, but occasionally is abroad during daylight hours. It is well adapted to an aquatic life and is one of the best swimmers of the nonmarine mammals. It can swim, dive, float, run along the bottom of a pond or creek, and actually run upon the surface of the water for some distance. Jackson (1961, p. 38) says that he once saw a water shrew run a distance of more than 5 feet across the surface of a pool. The body and head of the animal were entirely out of the water, the surface tension of the water supporting the shrew, and at each step the animal took there appeared to be a little globule of air held by the hair fringe on the hind feet.

Conaway (1952), writing of the western subspecies *navigator*, says that it apparently has an extensive breeding season since pregnant females have been collected in March, suckling females the first week in June, half grown young early in July, a female with five small embryos on August 2, and a male with enlarged testes on 9 August. The number of embryos varies from 4 to 8, and the gestation period is probably about 21 days. These shrews do not live long; Conaway estimates that the maximum age of any specimen obtained would not be in excess of 18 months.

The food of the water shrew consists largely of insect matter, chiefly beetles and their larvae, flies, caddisflies, and mayflies. Snails, leeches, small fish, and fish eggs are also consumed. Vegetable matter probably supplies only a small part of the diet.

SMOKY SHREW

Sorex fumeus fumeus Miller

Sorex fumeus Miller. North American Fauna, 10: 50, 31 December 1895.

Type locality.—Peterboro, Madison County, N.Y.

General distribution.—Eastern North America, from southeastern Ontario and central New England to the Smoky Mountains and northern Georgia. It has also been reported from central Kentucky (Barbour, 1951, p. 102) and southeastern Wisconsin (Jackson, 1928, p. 65).

Distribution in Maryland.—Higher elevations (above 2,000 feet) in the Allegheny Mountain section; may also occur at higher elevations in the Ridge and Valley section. It is not a common species in Maryland.

Distinguishing characteristics.—In summer pelage resembles *Sorex cinereus*, but is larger, has a longer tail, bigger feet, and somewhat

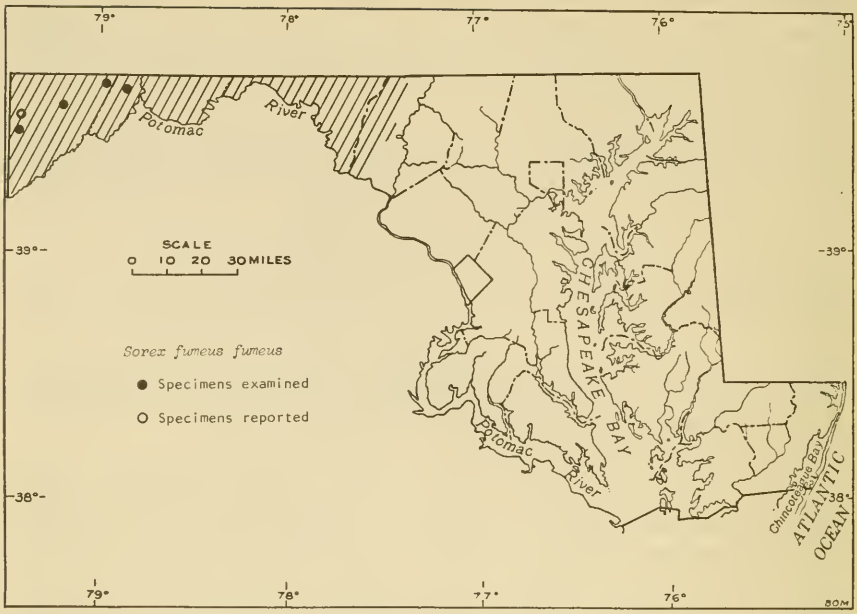

FIGURE 6.—Distribution of *Sorex fumeus fumeus*.

paler coloration. In winter pelage, coloration is grayish, and this shrew resembles *Sorex dispar*, but has a shorter tail. Tooth formula as in *Sorex cinereus*; third unicuspid larger than fourth.

Measurements.—Six adults from Finzel, Garrett County, 6 miles north of Frostburg, average as follows: Total length 110.8 (104–118); tail 44.5 (42–50); hind foot 13.2 (13–14); condylobasal length of skull (average of 3) 17.9 (17.7–18.2); cranial breadth (average of 4) 8.7 (8.6–8.9); least interorbital breadth 3.7 (3.6–3.9); maxillary breadth 5.0 (4.8–5.3); length of maxillary toothrow (average of 5) 6.7 (6.5–6.8).

Habitat and habits.—The smoky shrew is essentially a northern and mountain species and reaches its greatest abundance in the cool forested regions of New England, New York, and Pennsylvania. Most of Maryland apparently does not provide suitable habitat, for it is not a common species in the State. It prefers damp woods and bogs at the higher altitudes, where it lives under moss-covered logs and rocks. E. A. Preble's field notes report that the specimens collected at Finzel were taken in a hemlock and rhododendron swamp, and those at Bittinger, Garrett County, deep in a hemlock forest.

This shrew does not hibernate, and in general is active at all hours of the day and night. Its weak feet are not adapted for digging burrows, and it occupies those made by larger mammals such as the hairy-tailed mole, short-tailed shrew, red-backed mouse, and pine mouse. The

nests are located at various places in these tunnels, a favorite being under a log or stump. These nests, usually made of shredded leaves, are roughly spherical in shape and about the size of a baseball. They generally are situated some 4 to 19 inches below the surface of the ground.

Breeding in this species may begin in late March and the earlier litters appear in early May. As many as three litters may be produced each season, the last appearing in late August. The gestation period is about 20 days, and the young number from 3 to 10, 5 or 6 being the most common.

Hamilton (1940, p. 480) lists the foods of the smoky shrew as the following: insects, earthworms, vegetables, centipedes, snails, salamanders, mammals, sowbugs, spiders, and birds.

Hamilton (1943, p. 486) believes that adults, after completing their reproductive duties, die of old age when 14 to 17 months of age.

Specimens examined.—Allegany County: Mount Savage, 4 (Coll. U. Md.). *Garrett County:* Bittinger, 3; Finzel, 6; Swallow Falls State Forest, 3.

Other records and reports.—Garrett County: Cranesville Swamp, one mile SE (Coll. U. Mich.); Sang Run (Coll. Maryland Nat. Hist. Soc.).

LONG-TAILED SHREW

Sorex dispar dispar Batchelder

Sorex macrurus Batchelder, Proc. Biol. Soc. Washington, 10: 133, 8 December 1896. Not *S. macrourus* Lehmann, 1822.

Sorex dispar Batchelder, Proc. Biol. Soc. Washington, 24: 97, 15 May 1911. (A renaming of *S. macrurus* Batchelder.)

Type locality.—Beede's (sometimes called Lenne Heights), in township of Keene, Essex County, N.Y.

General distribution.—Mountainous regions of the eastern United States, from Maine south into North Carolina and Tennessee.

Distribution in Maryland.—Allegheny Mountain section; may occur at higher elevations in Ridge and Valley section. It has been taken in Maryland only at Muddy Creek Falls, in Swallow Falls State Forest, Garrett County (Mansueti and Flyger, 1952, p. 250). It is one of the rarest shrews in Maryland.

Distinguishing characteristics.—Similar to *Sorex fumeus*, but with a longer tail, somewhat smaller size, and a uniform slate-gray coloration in all pelages. Tooth formula as in *Sorex cinereus*, with third unicuspid equal to fourth in size.

Measurements.—External measurements of the type as given in the original description are: Total length 130; tail 60; hind foot 15; ear 10.

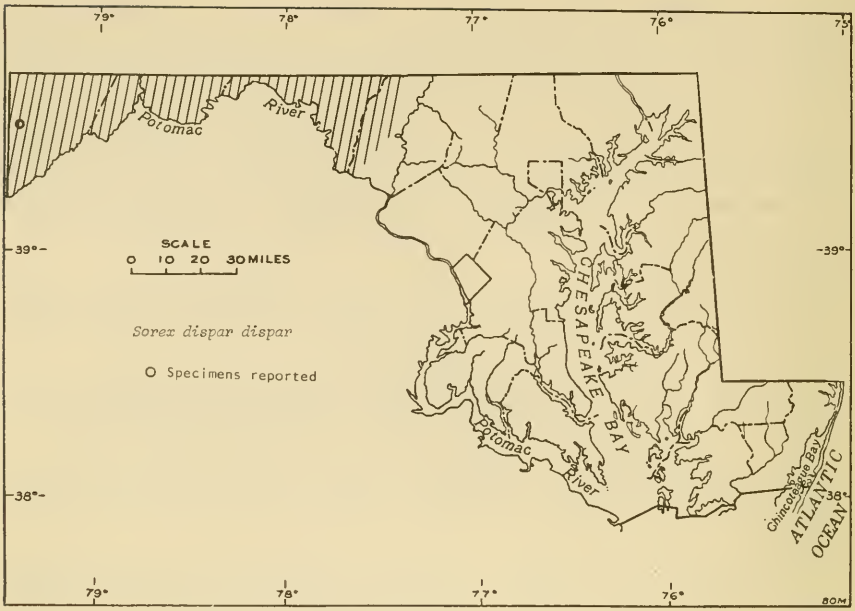

FIGURE 7.—Distribution of *Sorex dispar dispar*.

Some cranial measurements of the type as given by Jackson (1928, p. 90) are: Condylobasal length of skull 18.2; cranial breadth 8.1; interorbital breadth 3.5; maxillary toothrow 6.1.

Habitat and habits.—This shrew prefers moist rocky areas and the crevices between boulders, and large masses of rocks. It has also been taken under moss-covered logs in damp coniferous forests. Mansueti and Flyger (1952, p. 250) report that the three specimens they collected on 6 September 1950, at Muddy Creek Falls, in Swallow Falls State Forest, Garrett County, at an altitude of 2,200 feet, were taken in snap traps placed on ledges in crevices of outcropping sandstone 2 or 3 feet above a small stream's level in a relatively cool moist hemlock and rhododendron forest. Charles O. Handley, Jr. (1956, p. 435) says that the Virginia specimen he took on Big Mountain, Giles County, in September of 1955 was secured in a trap set about 12 inches below the surface in a patch of talus.

Very little is known of the habits of this species, but in all probability it differs little from other long-tailed shrews. Hamilton (1943, p. 39) says that G. H. H. Tate collected a female with 2 embryos in late August in the Adirondack Mountains of New York.

Records and reports.—Garrett County: Swallow Falls State Forest, at Muddy Creek Falls (Mansueti and Flyger, 1952).

PIGMY SHREW

Microsorex hoyi winnemana Preble

Microsorex winnemana Preble, Proc. Biol. Soc. Washington, 23: 101, 24 June 1910.

Type locality.—Bank of Potomac River near Stubblefield Falls, Fairfax County, Va.

General distribution.—Maryland, south into western North Carolina.

Distribution in Maryland.—May occur in all sections, but is rare. It has been taken in Maryland only at Berwyn, Prince Georges County.

Distinguishing characteristics.—This is the smallest mammal in North America and possibly the smallest in the world with respect to weight. Externally it resembles *Sorex cinereus* and *Sorex longirostris*, but is smaller and darker (less reddish) and has a shorter tail. Although the tooth formula is the same as that of the genus *Sorex*, there are certain peculiarities in the upper unicuspid toothrow which distinguish it. The third upper unicuspid is minute and disklike, compressed anteroposteriorly between the second and fourth unicuspids, and is not visible when the jaw is viewed laterally. The fifth unicuspid is minute and peglike, and is also not visible in side view, so that only three unicuspids can be seen in the side view of the upper jaw (first,

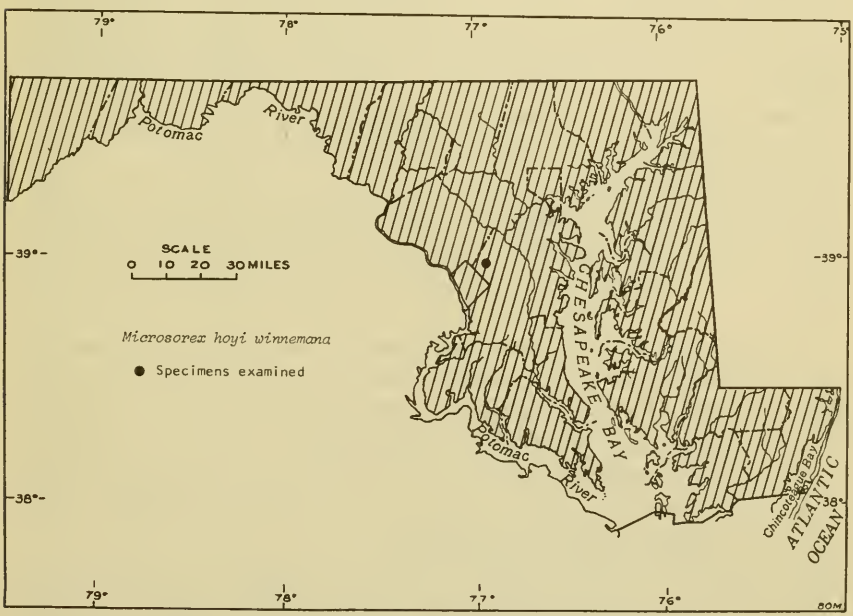

FIGURE 8.—Distribution of *Microsorex hoyi winnemana*.

second, and fourth). This differs from the genus *Sorex* in which four or five unicuspids are always visible when the skull is viewed laterally.

Measurements.—External measurements of the Berwyn specimen are as follows: Total length 86; tail 29; hind foot 9.5. The skull of this specimen is crushed, but some cranial measurements of the type, as given by Jackson (1928, p. 210) are: Condylobasal length of skull 13.0; cranial breadth 6.1; interorbital breadth 2.7; maxillary toothrow 4.1.

Habitat and habits.—These rare shrews are little known. The type specimen was dislodged from the decayed interior of a large fallen log, and the specimen from Berwyn was found in the decayed heart of a dead chestnut tree, cut from a dry hillside at some distance from water.

Specimens examined.—Prince Georges County: Berwyn, 1.

SHORT-TAILED SHREW

Blarina brevicauda kirtlandi Bole and Moulthrop

Blarina brevicauda kirtlandi Bole and Moulthrop, Sci. Publ. Cleveland Mus. Nat. Hist., 5: 99, 11 September 1942.

Type locality.—The Holden Arboretum, Kirtland Township, Lake County, and Chardon Township, Geauga County, Ohio. (The county line bisects the type locality.)

General distribution.—Ranges from northwestern Michigan, eastern Wisconsin, and Illinois, east throughout most of Pennsylvania to central New Jersey and southward through Delaware, Maryland, and West Virginia to southwestern Virginia.

Distribution in Maryland.—Abundant in suitable habitat in all sections of the State.

Distinguishing characteristics.—A large, short-tailed, slate-colored shrew, with a shorter blunter muzzle than any of the shrews previously discussed. The tooth formula is as in *Sorex*, with the fifth unicuspid being minute. The teeth are generally darkly tinged with reddish brown.

Measurements.—Thirty-seven adults from the vicinity of Annapolis, Anne Arundel County, average as follows: Total length 115.2 (107–122); tail 23.3 (19–27); hind foot 14.4 (13–15). Seventeen adults from the vicinity of Annapolis have the following cranial measurements: Condylobasal length 21.9 (20.8–22.7); mastoidal breadth 12.1 (11.4–12.8); interorbital breadth 5.8 (5.3–6.1); maxillary breadth 7.7 (7.3–8.0); unicuspid toothrow 8.6 (7.9–8.9).

Measurements of eight adults from Cambridge, Dorchester County (Coll. K.U.), are: Total length 103.6 (101–107); tail vertebrae 23.1 (20–25.5); hind foot 13.6 (13–14.5); condylobasal length of skull 21.0

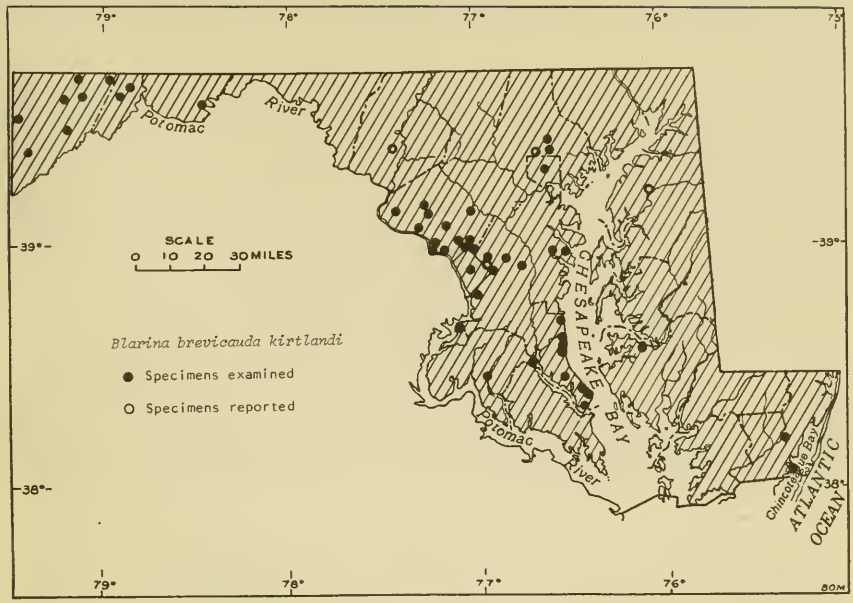

FIGURE 9.—Distribution of *Blarina brevicauda kirtlandi.*

(20.5–21.7); mastoidal breadth 11.3 (11.0–11.7); interorbital breadth 5.4 (5.3–5.6); maxillary breadth 7.3 (7.1–7.6); unicuspid toothrow 7.6 (7.2–8.2).

Habitat and habits.—This is one of the most abundant mammals in Maryland. It is found in a wide variety of habitats, but is most numerous in damp woods where there is a thick understory. It is also encountered in meadows and old fields, but not on the Atlantic barrier beaches of the Delmarva Peninsula, where many weeks of trapping on Assateague Island failed to uncover a single specimen. Elsewhere in the State, this shrew vies with the meadow mouse and the white-footed mouse in abundance, but does appear to be cyclical as regards numbers, and in some years is more plentiful than in others.

The short-tailed shrew, like other Maryland shrews, is active the year around, neither hibernating nor migrating. It is abroad both during daylight hours and at night. It is quick and energetic in its actions, and appears to be constantly on the go during its periods of activity. Its runways zigzag in all directions and lie on the surface of the ground just beneath the vegetation or litter. In these runways, the short-tailed shrew constructs two types of nests. One of these is a small resting nest, and the other a much larger breeding nest. The latter may be some 6 to 10 inches long and averages about 4 inches in diameter. The nests are made of leaves, shredded grasses, and other

vegetable fibers. In general, these nests are not as finely made as most mouse nests.

The breeding season for this species extends from March to September, and usually two or three broods of young are reared each season. The gestation period is from 21 to 22 days, and between 3 and 10 young may be produced, although the average number is slightly below 7. These young leave the nest in 18 to 20 days, and by the time they are 3 months of age they are essentially mature animals. This shrew may live up to 3 years, but the life span is usually less than this, probably not more than 18 or 20 months.

This species has a voracious appetite. Hamilton (1930, p. 30) found that an examination of 244 intestinal tracts from New York State *Blarina* yielded the following food percentages: Insects 47.8, arachnids 2, millipedes 1.7, vertebrates 4.1, crustaceans 6.7, mollusks 5.4, annelids 7.2, centipedes 3.8, plant matter 11.4, inorganic matter 2.3, and undeterminable material 5.2. Only 1.7 percent of the stomachs examined were empty.

The bite of this shrew is poisonous. Pearson (1942) found that a poisonous extract could be prepared from the submaxillary salivary glands of this species and that a toxic material is also present in the saliva and may be introduced into wounds made by the teeth, but because of the small size of the animal its bite probably would have little if any effect on man. There have been reports, however, of distress following the bite of a shrew. Maynard (1889) says that when he was bitten by one of them he experienced considerable pain and swelling in the vicinity of the wound which persisted for a week or longer. Others have been bitten repeatedly by shrews of this species and have experienced no after effects whatsoever other than the distress accompanying the actual breaking of the skin by the sharp teeth.

These shrews appear to be somewhat more gregarious than most other species of shrews. It is not uncommon to capture a specimen each night for 4 or 5 consecutive nights in a trap set in the same place, indicating that the animals are using the same runways if not actually associating with each other. It may be stated, however, that in general this shrew is solitary and pugnacious both to its own kind and to any other creature it may encounter.

Specimens examined.—Allegany County: Frostburg, 1 (Coll. Frostburg State College); Mount Savage, 42; Oldtown (near), 7. *Anne Arundel County:* Annapolis (near), 40; South River and U.S. Route 50 (junction of), 1. *Baltimore City:* 1. *Baltimore County:* Dulaney Valley, 1; Loch Raven, 1. *Calvert County:* Breezy Point, 2; Chesapeake Beach, 1; Cypress Swamp along Battle Creek, 2; Hungerford Creek, 3½ miles N of Solomons, 1; Marine Training Base, ¾ mile N of Solomons, 13; Plum Point, 1; Scientist Cliffs, 2; Solomons, 2. *Charles*

County: Benedict, 1; Marshall Hall, 1; Newport, 7. *Dorchester County:* Cambridge, 15 (14 in Coll. K.U.). *Garrett County:* Bittinger, 5; Cranberry Swamp, 1; Finzel, 13; Grantsville, 5; Mountain Lake Park, 2; Swallow Falls State Forest, 2; Swanton, 4; Wolf Swamp, 2. *Montgomery County:* Burnt Mills, 2; Cabin John, 1; Cropley, 2; Germantown, 1; Kensington, 1 mile N, 2; Plummers Island, 3; Poolesville, 1; Rockville, 17; Rockville, 2.3 miles NE, 6; Sandy Spring, 6; Seneca, 3; Sececa Creek at Clopper Road (Route 117), 1; Silver Spring, 6; Takoma Park, 1. *Prince Georges County:* Northwest Branch Anacostia River, 1; Hyattsville, 5; Lanham, 1; Laurel, 4; Mitchellsville, 1 mile W., 2; Oxon Hill, 12; Prince Georges County Sphagnum Bog, 1. *Worcester County:* Mills Island, 2 (skulls from owl pellets); Snow Hill, 5 miles NE, 1. *District of Columbia:* 107.

Other records and reports.—Baltimore County: Lake Roland (Bures, 1948, p. 62); Towson (Gentile, 1949, p. 11). *Frederick County:* Locust Grove (Merriam, 1895, p. 13). *Kent County:* Chestertown (U.S. Fish and Wildlife Service files). *Prince Georges County:* Bladensburg (Bailey, 1896, p. 100).

Remarks.—This species is in need of revision throughout its range. Pending this, only tentative conclusions may be reached regarding the various races and their distribution. At present it appears that three subspecies are distributed along the northeastern coast of the United States. The most northerly race, *talpoides*, ranges throughout most of New England, New York, extreme northern Pennsylvania, and northern New Jersey. It is a large pale race, with an elevated cranium and a long slender rostrum. Distribtued along the east coast to the south of *talpoides* is *kirtlandi* from northeastern Ohio, ranging throughout most of Pennsylvania, central and southern New Jersey, Delaware, Maryland, and West Virginia into southwestern Virginia. It is somewhat smaller and darker than *talpoides* and has a shorter, broader rostrum. Distributed to the south of *kirtlandi* is the very small dark southern race *carolinensis*. Several authorities have considered the range of *carolinensis* to extend north to Cambridge, Dorchester County, Md. (Bole and Moulthrop, 1942, p. 108; Gardner, 1950a, p. 67; Jones and Findley, 1954, p. 210). I have examined a number of specimens from this locality (as well as series from farther south on the Delmarva Peninsula) and consider them to be intergrades between *carolinensis* and *kirtlandi*, but closer to *kirtlandi* and referable to that race. The intergrading character of this population is reflected primarily in smaller size, particularly as regards external measurements. The average total length of eight specimens from Cambridge is 103.6 mm. as contrasted with 97.4 mm. for eight specimens from South Carolina (near the type locality of *carolinensis*) and 116 for the type specimen

of *kirtlandi* from northeastern Ohio. Cranially, eight adults from Cambridge average closer in size to *kirtlandi* and have an average condylobasal length of 21.0 and a mastoidal breadth of 11.3, contrasted with an average condylobasal length of 18.4 and mastoidal breadth of 10.1 in typical *carolinensis* (25 specimens from Raleigh, N.C.) and 21.0 and 11.9 in the type specimen of *kirtlandi*. Apparently the entire southern portion of the Delmarva Peninsula is an area of intergradation between *kirtlandi* and *carolinensis*. Specimens I have examined from near Wattsville, Accomack County, Va., and Cape Charles at the southern tip of the Delmarva Peninsula in Northampton County, Va., although still decidedly referable to *kirtlandi*, are smaller in size both externally and cranially than typical *kirtlandi* and appear to be approaching *carolinensis*.

LEAST SHREW

Cryptotis parva (Say)

Sorex parvus Say, in Long, Account of an expedition from Pittsburg to the Rocky Mountains, . . . 1: 163, 1823.

Type locality.—West bank of Missouri River, near Blair, formerly Engineer Cantonment, Washington County, Nebr.

General distribution.—The species is distributed over most of the eastern and midwestern United States, from central New York, Michigan, Wisconsin, Minnesota, and South Dakota, south to Florida in the east, and northeastern Mexico in the west.

Distribution in Maryland.—Occurs in all sections of the State.

Distinguishing characteristics.—Teeth 3/1, 1/1, 2/1, 3/1, = 30; small size; brownish coloration; short tail. Most closely resembles *Blarina brevicauda* but is smaller, more brownish, and has 30 teeth instead of 32. It may be distinguished from all other shrews in Maryland by its short tail.

Measurements.—Six adults from 3/4 mile N of Solomons Island, Calvert County, measury as follows: Total length 76.3 (74–80); tail 15.2 (14–16); hind foot 10 (10–11); condylobasal length of skull 15.2 (15.0–15.6); palatal length 6.5 (6.4–6.9); cranial breadth 7.7 (7.6–8.0); interorbital constriction 3.6 (3.5–3.7); maxillary breadth 5.0 (5.0–5.1); molar toothrow 5.4 (5.2–5.6).

Habitat and habits.—Most commonly found in dry fallow fields and stubble in the uplands, and in the marshes in the coastal areas. This shrew appears to be abundant in some places, and scarce or absent in almost identical habitat elsewhere. Along with *Microtus pennsylvanicus*, it is the most frequently taken small mammal on Assateague Island, where it occurs everywhere except on the sparsely vegetated beach dunes. Another area of abundance for the species is the dry fallow fields of southern Maryland. In such a field, three-fourth mile

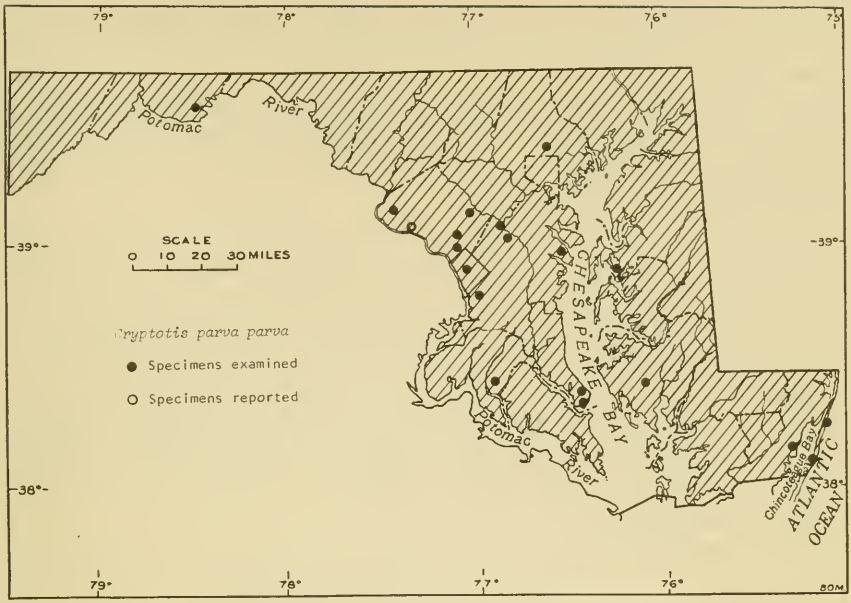

FIGURE 10.—Distribution of *Cryptotis parva parva.*

N of Solomons, Calvert County, this shrew was taken in traps as often as the short-tailed shrew and the house mouse.

This small shrew generally follows the runways of larger mice and shrews, but it also constructs runways of its own. In soft ground it sometimes uses its snout to push dirt away, and by worming its way along may make a tunnel. These small burrows are not much different from those made by certain large beetles or other insects and are difficult to identify. The nest of this species is usually placed in a slight hollow on the surface of the ground, or under a rock or log. Rarely is it located beneath the ground and then only at a depth of 4 or 5 inches or less. Sometimes it will utilize artificial objects such as tin cans in which to nest. The structure of the nest is globular, and composed of dry grass and leaves.

The breeding season for this species is from March to November, and young, born early in the spring, usually breed within the year. The gestation period is about 16 days, and between four and five broods may be produced during a season. The number of young per litter varies from three to nine, with the usual number being four to six.

The food of this species, like that of other shrews, consists primarily of insects and other animal matter. It is known to eat beetles, bugs, grasshoppers, earthworms, millipedes, and snails. It is also said to be fond of salamanders, frogs, and broods of young honeybees.

Unlike most other shrews, the least shrew is gregarious, and may be said to be almost colonial in habits. Jackson (1961, p. 58) says that often when a log, slab, or rock is overturned four to eight or more of these little shrews may be found living together underneath. Maurice K. Brady of Washington, D.C., told Jackson that in Virginia near Washington in 1925 he uncovered a nest of this species which contained 25 *Cryptotis*, all in a pile.

Specimens examined.—Allegany County: Oldtown, 9 miles E, 1. *Anne Arundel County:* Annapolis (vicinity), 2. *Baltimore County:* Lock Raven Reservoir, 1. *Calvert County:* Solomons, 1; Solomons, ¾ mile N, 7. *Charles County:* Newport, 1. *Dorchester County:* Blackwater National Wildlife Refuge, 1. *Montgomery County:* Bethesda, 1; Kensington, 13; Poolesville, 1; Sandy Spring, 19. *Prince Georges County:* Laurel, 6; Oxon Hill, 1; Patuxent Research Center, 5. *Queen Annes County:* Parson Island, 1. *Worcester County:* Ocean City, 4 and 5 miles S, 7; Ocean City, 15 miles S, 1; Chincoteague Bay, 2. *District of Columbia:* 8.

Other records and reports.—Montgomery County: Seneca (Kilham, 1954, p. 252).

Remarks.—This species is in need of revision over its entire range. Until this revision is completed, all specimens from Marvland are provisionally referred to *Cryptotis parva parva.*

Family TALPIDAE (moles)

HAIRY-TAILED MOLE

Parascalops breweri (Bachman)

Scalops breweri Bachman, Boston Jour. Nat. Hist., 4: 32, 1842.

Type locality.—Martha's Vineyard, Massachusetts (there is some question, however, whether this species ever occurred on Martha's Vineyard Island).

General distribution.—Northeastern United States and adjacent Canada, south in the Appalachians to western North Carolina.

Distribution in Maryland.—Occurs at higher elevations in the Allegheny Mountain and Ridge and Valley sections.

Distinguishing characteristics.—Teeth 3/3, 1/1, 4/4, 3/3, = 44; tail short and hairy; coloration dark slate to black dorsally, slightly paler below; pelage soft and thick, but somewhat coarser than in the eastern mole (*Scalopus aquaticus*); palms enlarged and nearly circular in outline; toes not webbed.

This species can readily be distinguished from the eastern mole by its hairy tail, and from the star-nosed mole (*Condylura cristata*) by the absence of nasal projections.

Measurements.—Jackson (1915: 80) gives external measurements of eight males from Magnetic City, N.C., as follows: Total length 149.5

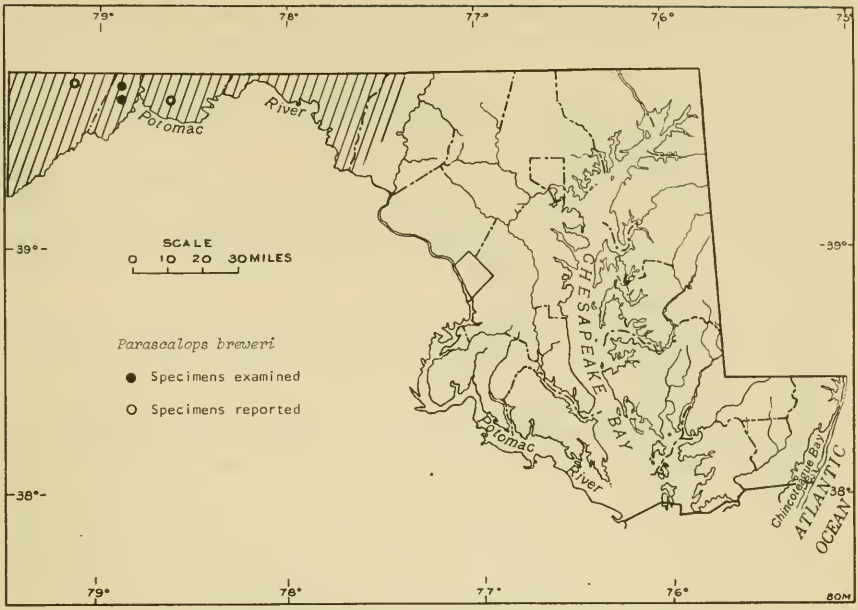

FIGURE 11.—Distribution of *Parascalops breweri.*

(139–152); tail vertebrae 30 (23–36); hind foot 19.5 (18–20). He gives some measurements of the skulls of 10 adult males from Magnetic City as follows: Greatest length 32.4 (31–33.8); mastoidal breadth 14.5 (13.9–15); interorbital breadth 7.3 (7.1–7.5); maxillary toothrow 9.9 (9.2–10.2). Females average smaller than males.

A male (probably immature) from Vale Summit Road, between Clarysville and Vale Summit, Allegany County, has the following external measurements: total length 136; tail 22; hind foot 16. This animal weighed 35.7 grams.

Habitat and habits.—In Maryland this mole is found only at high elevations in the western part of the State, where it lives in loose well-drained light soils. It may be found in pastureland, as well as in the deep woods, but is seldom encountered in damp areas or in clay soils. Although the eastern mole (*Scalopus aquaticus*) also occurs in western Maryland, it appears to be ecologically or at least altitudinally separated from the hairy-tailed mole. The eastern mole has been taken in the lowlands; the hairy-tail only at higher elevations.

This species makes irregular subsurface runways which form an elaborate network. In the winter these tunnels are deep so as to avoid the freezing temperatures of the upper layers of earth. Nests are constructed in these deep burrows, some 10 to 20 inches below the surface of the ground. These are made of dried grasses and leaves, and are some 6 inches in circumference.

Mating occurs in March or April, and four to five young are produced in late April or May after a gestation period of probably a month. The young moles develop rapidly and are able to shift for themselves within a month. They are sexually mature and able to breed the following spring.

The primary foods of this species are earthworms, insects, insect larvae, and other arthropods. They are very voracious eaters, and Hamilton (1943, p. 27) reports that a captive mole of this species weighing 50 grams consumed 66 grams of earthworms and insect larvae within a 24-hour period.

Specimens examined.—Allegany County: Mount Savage, 1. (Coll. U. Md.); Vale Summit Road, between Clarysville and Vale Summit, 1 (Coll. U. Md.).

Other records and reports.—Allegany County: Warrior Mountain (U.S. Fish and Wildlife Service files). *Garrett County:* Grantsville, near (Coll. U. Mich.).

Remarks.—Two specimens of this species from Grantsville, Garrett County, collected 28–29 August 1949 by J. A. King, and now stored in the Museum of Zoology, University of Michigan, are the first actually taken in this State. The species, however, is probably not as rare in western Maryland as the few trapping records and reports would indicate.

EASTERN MOLE

Scalopus aquaticus aquaticus (Linnaeus)

(*Sorex*) *aquaticus* Linnaeus, Syst. Nat., ed. 10, 1: 53, 1758.

Type locality.—Philadelphia, Pa. (Fixed by Jackson, N. Amer. Fauna 38, p. 33, 30 September 1915).

General distribution.—Eastern United States, from southern New England, and New York State, south to Virginia, and in the Appalachian Mountains south to Tennessee, North Carolina, and South Carolina.

Distribution in Maryland.—Eastern Shore, Western Shore, and Piedmont sections and at lower elevations in the Ridge and Valley and Allegheny Mountain sections. Rare or absent apparently in the Ridge and Valley, and Allegheny Mountain sections at elevations over 2,000 feet.

Distinguishing characteristics.—Teeth 3/2, 1/0, 3/3, 3/3, = 36; forefeet broad and greatly enlarged, adapted for digging; body stout and cyclindrical; pelage soft and velvety, black to brownish black in coloration; tail short and naked; eyes and ears small and not visible on superficial examination.

Differs from the hairy-tailed mole (*Parascalops breweri*) in that the tail is short and naked, and from the star-nosed mole (*Condylura cristata*) in that the snout is without fleshy projections.

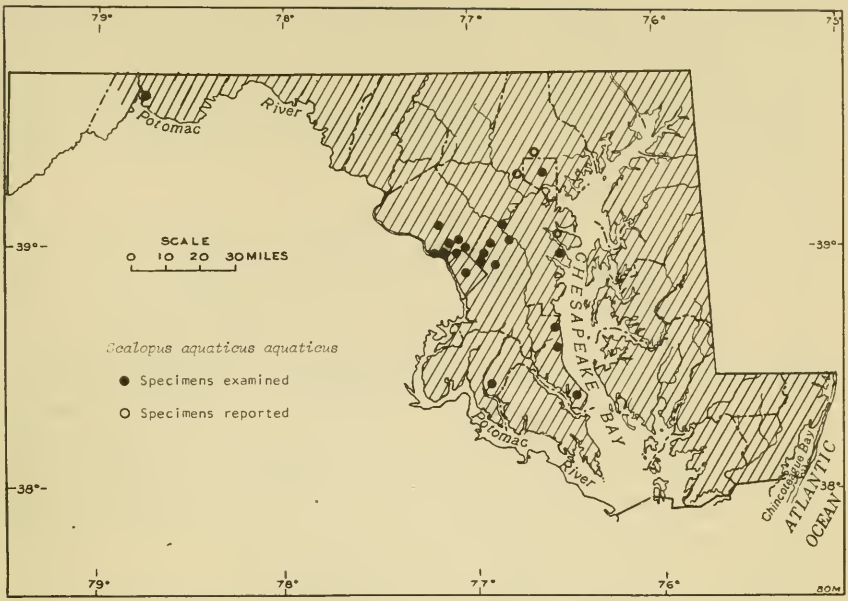

FIGURE 12.—Distribution of *Scalopus aquaticus aquaticus*.

Measurements.—Jackson (1915, p. 34) gives external measurements of 15 adult males from Washington, D.C., as follows: Total length 163.4 (154–175); tail vertebrae 26.5 (22–29); hind foot 19.8 (18–21). Cranial measurements for 21 adult males fromWashington and vicinity are: Greatest length 34.3 (33.2–35.6); mastoidal breadth 17.7 (17–18.3); interorbital breadth 7.4 (7.2–7.8); maxillary toothrow 10.8 (10.4–11.3). Females average smaller than males in size.

Habitat and habits.—The eastern mole normally lives in sandy soils and light loams in meadows, pastures, cultivated fields, gardens, lawns, and thin woods. Rocky areas and swamps are generally avoided since they are barriers to the mole's burrowing activity. It does, however, prefer moist situations to dry ones. Very sandy regions, such as the barrier beaches that line Maryland's ocean front, are apparently unfavorable to the eastern mole, and many weeks of searching for their signs near Ocean City, Worcester County, and on Assateague Island to the south proved fruitless. Bures (1948, pp. 61–62), found moles in the Bare Hills–Lake Roland area of Baltimore County to be restricted to the moist or wet soil bordering the Lake and along the two streams that empty into Jones' Falls. He says that numerous individuals were observed at work on the lawns of property fronting Falls Road. In the Ridge and Valley and Allegheny Mountain sections, there is evidence that this species occurs only in the lowlands, whereas higher up on the

mountains it is replaced by the hairy-tailed mole. In Mason County, W. Va., McKeever et al. (1952, p. 25) found an eastern mole inhabiting the sandy soil of the Ohio River bottomland and a hairy-tailed mole in the nearby forest-covered hills. This distribution occurs in the Appalachians in general, including the Ridge and Valley and Allegheny Mountain sections of Maryland.

The eastern mole does not hibernate, but is active the year round. It constructs a series of burrows just beneath the surface of the ground during wet weather to facilitate the capture of earthworms which form a major part of its diet. In dry and cold weather this species digs deeper permanent burrows some 10 or more inches below the surface. Rarely does the eastern mole emerge from its subterranean burrows and prowl about above ground. A nest is built in one of the permanent burrows, which may be from 5 to 18 inches down, usually under the roots of shrubs or stumps. It is most often made from grass and rootlets, but occasionally leaves are employed. This nest is placed on the bottom of a flattened ellipsoidal enlargement of the tunnel, the length of which is about 8 inches and the diameter about 5.

Mating in this species takes place in March and continues into April. The young are born in the latter part of April or in May. The gestation period is about 45 days, and from two to five young are born each season. By the time a young mole is 5 weeks of age it is more than half the size of the mother.

Eighty percent of the diet of the eastern mole is animal matter, consisting primarily of worms, insects, and insect larvae. Some of the favorite foods are beetles, earthworms, wireworms, white grubs, spiders, centipedes, millipedes, slugs, and insect and mollusk eggs. Some of the plant matter consumed are corn, potatoes, grass, tomatoes, apples and occasionally wheat and oats. The eastern mole is a voracious eater and in 24 hours may consume a quantity of food equal to its weight.

Moles are harmful when they disfigure lawns and provide highways in gardens for field and pine mice. Their destruction of insects places them in a more favorable light. A friend once told me that these moles had almost eliminated the larvae of Japanese beetles on his grounds. Tunneling activities of moles aid in the formation of soil. (Hamilton, 1943, pp. 23–24).

Specimens examined.—Allegany County: Cumberland, 3 (Coll. U. Md.). *Anne Arundel County:* Annapolis, 3 miles NW, 1; no exact locality, 2. *Baltimore City:* 2. *Calvert County:* Chesapeake Beach, 1; Plum Point, 1; Solomons, 4 miles N, 1. *Charles County:* Newport, 3. *Howard County:* no exact locality, 1 (embryo in alcohol). *Montgomery County:* Cabin John, 2; Capitol View, 1; Chevy Chase, 1; Plummers Island, 5; Rockville, 2; Seven Locks, 1; Silver Spring, 4; Woodside, 4. *Prince Georges County:* Beltsville, 2; Berwyn, 1; Branchville,

4; Brookland, 1; Highland, 1; Landover, 2; Laurel, 13; Mount Rainier, 1; Patuxent Research Center, 1. *District of Columbia:* 83.

Other records and reports.—Anne Arundel County: Severna Park (Cooper, 1953, p. 79). *Baltimore County:* Lake Roland (Bures, 1948, p. 61); Patapsco State Park (Hampe, 1939, p. 5). *Montgomery County:* Forest Glen (Bailey, 1896, p. 100).

STAR-NOSED MOLE

Condylura cristata cristata (Linnaeus)

(*Sorex*) *cristatus* Linnaeus, Syst. nat., ed. 10, 1: 53, 1758.

Type locality.—Eastern Pennsylvania.

General distribution.—Southeastern Canada, and northeastern United States, south to central Minnesota, Wisconsin, Indiana, Ohio, eastern West Virginia, and northern Virginia.

Distribution in Maryland.—Locally abundant in all sections of the State although apparently rare or absent in some areas with suitable habitat.

Distinguishing characteristics.—Teeth 3/3, 1/1, 4/4, 3/3, = 44; body form mole-like, but more slender; forefeet broad and enlarged for digging, but not to the same extent as in *Scalopus;* pelage black in coloration, somewhat harsher in texture than that of *Scalopus;* tail long, and at certain times of the year enlarged. The most distinctive feature of this mole is the snout, which is fringed with 22 pink projections, or tentacles, and is responsible for the popular name of the animal.

Measurements.—Two adults from the District of Columbia measure as follows: Total length 183, 185; tail vertebrae 65, 66; hind foot 28, 28; greatest length of skull 33.9, 33.4; mastoidal breadth 12.8, 12.8; interorbital breadth 6.8, 6.7; maxillary toothrow 6.6, 6.3.

Habitat and habits.—The star-nosed mole prefers damp habitat in meadows, fields, woods, or swamps, but is sometimes taken in the leaf mold of dense forests, or in relatively dry fields in which there are a few damp spots from which its tunnels radiate. Occasionally it is found at a considerable distance from any water. One specimen was captured in June 1958 in the lower Eastern Shore section near Wattsville, Accomack County, Va., a few miles from the Maryland boundary. It was taken in a museum special mouse trap set in a surface runway in dry meadow at least a fourth of a mile from the nearest water. Generally, however, the star-nosed mole will be encountered in very wet situations, and its tunnels frequently lead directly into a stream or pool. This animal is an efficient swimmer, using its broad forefeet as oars and its tail as a scull.

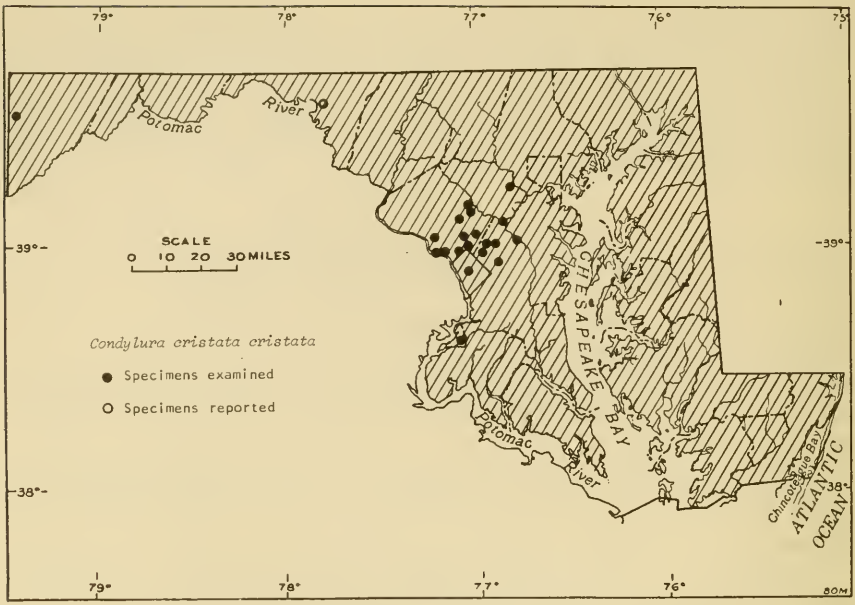

FIGURE 13.—Distribution of *Condylura cristata cristata*.

The star-nosed mole is less fossorial than the eastern or hairy-tailed moles; it is active both day and night, summer and winter. It often uses surface runways, and sometimes in the winter it will burrow in the snow, or even run across it. The tunnels that this species digs are more irregular in pattern than those of other Maryland moles. These burrows are deep in places, and then abruptly rise to near the surface. Frequently the tunnels enter the bank of a stream a foot or more below the water line. The nest of the star-nosed mole is constructed of leaves and grass and is located in a flattened spherical chamber about 5 or 6 inches in diameter and some 4 or 5 inches high. It is usually placed 3 or 4 inches below the surface of the ground, but may be as much as 10 inches down. It is always, however, above the high water level.

It is believed that star-nosed moles pair in the autumn and remain together until the young are born. Breeding occurs in the spring, and birth is from April to June, the gestation period being about 45 days. There is only a single litter per year, and the size of the litter varies from three to seven, six being the usual number. The young mature rapidly and are ready to leave the nest within about a month's time. Star-nosed moles are more gregarious than other eastern moles, and may perhaps, be colonial, although colonies are probably formed through family lineage.

Star-nosed moles are amphibious, and spend a good deal of time in water. They are excellent swimmers and divers, and a large portion of their food consists of aquatic insects and worms, only about one fourth of the diet being composed of terrestrial forms.

Specimens examined.—*Charles County:* Marshall Hall, 1. *Garrett County:* Cranesville Swamp, 1. *Howard County:* Ellicott City, 1. *Montgomery County:* Brookeville, 1; Burnt Mills, 1; Cabin John, 1; Chevy Chase, 1; Chevy Chase Lake, 1; Oakdale, 1; Plummers Island, 1; Potomac P.O., 1; Sandy Spring, 1; Silver Spring, 1; Woodside, 2. *Prince Georges County:* Beltsville, 1; College Park, 2; Glenndale, 1; Lanham, 1; Laurel, 2; Patuxent River Marsh, 1; no exact locality, 1. *District of Columbia:* 10.

Other records and reports.—*Prince Georges County:* Branchville (U.S. Fish and Wildlife Service files). *Washington County:* Williamsport (Jackson, 1915, p. 91).

Remarks.—Maryland specimens average somewhat smaller in size, both externally and cranially than typical *C. c. cristata*, and are tending in this character toward the smaller southern subspecies *C. c. parva.*

Order CHIROPTERA (bats)

Family VESPERTILIONIDAE (vespertilionid bats)

LITTLE BROWN MYOTIS

Myotis lucifugus lucifugus (Le Conte)

V[*espertilio*]. *lucifugus* Le Conte, *in* McMurtrie, The animal kingdom . . . by the Baron Cuvier, vol. 1, App., p. 431, 1831.

Type locality.—Georgia; probably the Le Conte plantation near Riceboro, Liberty County.

General distribution.—Eastern and northern North American from Alaska and Labrador south in the Appalachians to Georgia, and west into Arkansas.

Distribution in Maryland.—Abundant in all sections of the State.

Distinguishing characteristics.—Teeth 2/3, 1/1, 3/3, 3/3, = 38; face covered with fur except for lips and nostrils; ears moderately long, not extending beyond nostrils when laid forward; tragus slender and pointed; wing membrane between humerus and knee sparsely furred; interfemoral membrane not furred; coloration rich brown, almost bronze; young animals much darker in coloration; sagittal crest usually lacking on skull.

Measurements.—Eight adults from the District of Columbia have external measurements as follows: Total length 85.6 (80–95); tail vertebrae 38.5 (36–42); hind foot 8.9 (8.0–10.5). Some cranial measurements of seven adults from Washington, D.C., are as follows:

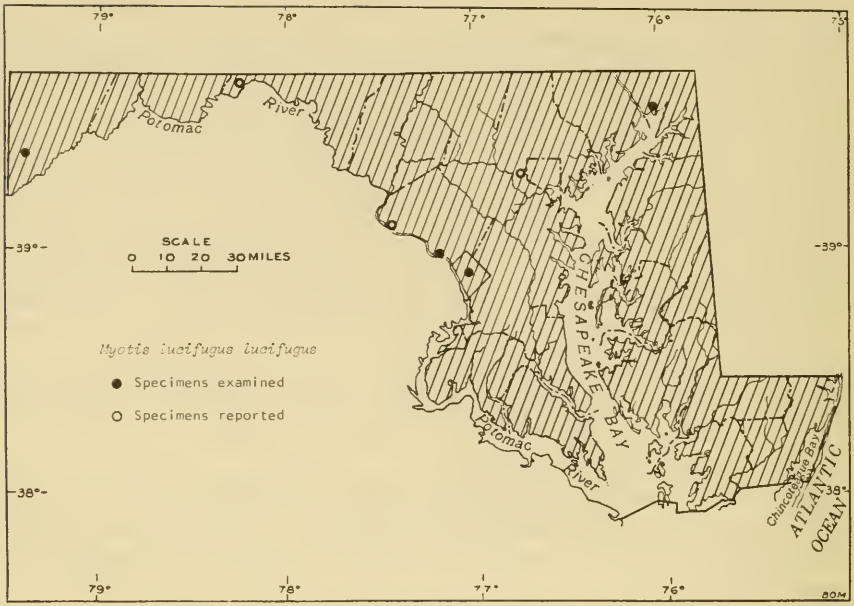

FIGURE 14.—Distribution of *Myotis lucifugus lucifugus*.

Greatest length 14.0 (13.7–14.2); zygomatic breadth 8.4 (8.0–9.1); interorbital breadth 4.0 (3.9–4.2); length of maxillary toothrow 5.1 (5.0–5.2).

Habitat and habits.—This species occurs almost everywhere, roosting in the attics of houses, in hollow trees, or in caves. It is gregarious by nature; in the attic of one house near Seneca Point, Cecil County, over 9,000 were found roosting at one time.

The little brown myotis hibernates in winter and, in some areas at least, is migratory in habits, traveling "flyway" routes from winter hibernating quarters to summering areas. During these migrations they may travel as far as 100 to 150 miles or more, returning by similar routes to their winter quarters. The migratory patterns of Maryland's little brown myotis have not been studied, but the files of the Bat Banding Office, U.S. Fish and Wildlife Service, contain two records of movements of this species into the State. In both instances, the little brown myotis were banded in Hellhole Cave, Pendleton County, W. Va., in March 1964 and were picked up in the vicinity of Deep Creek Lake in Garrett County in June and July of 1964. Perhaps some of Maryland's *Myotis lucifugus* population winters in caves in West Virginia and Virginia, and travels north to forage in Maryland during the summer. Others that winter in Maryland may venture further north into Pennsylvania in the summer months.

Mating in this species usually occurs in the autumn, before the bats enter hibernation. Normally the spermatozoa survive in the uterus throughout the winter, and fertilization occurs the following spring. Copulation, however, may occur during the winter or in the spring. The gestation period probably is about 80 days, and the young are born in late May or early June. Usually only a single offspring comprises a litter, but occasionally two are produced. In about 4 weeks after their birth, the young are flying and foraging for their own food. Sexual maturity is achieved at about 8 months. There is only one litter per season.

The food of the little brown myotis appears to be composed entirely of insects, particularly nocturnal species of moths, beetles, and bugs. It has a voracious appetite, consuming large numbers of insects nightly.

This bat is long-lived; there are records of banded animals recovered in good health as much as 20 years after banding.

Specimens examined.—Cecil County: Seneca Point, 1. *Garrett County*: Oakland, 1. *Montgomery County*: Plummers Island, 1. *District of Columbia*: 29.

Other records and reports.—Baltimore County: Patapsco State Park (Bull. Nat. Hist. Soc. Maryland 10 (1), p. 5, 1939). *Garrett County:* Deep Creek Lake (banding recovery record). *Montgomery County:* Edwards Ferry (banding recovery record). *Washington County:* Round Top Mountain, near Hancock (banding record).

Remarks.—This bat is far more common than the few locality records above would indicate. It is probably the most abundant bat in Maryland.

KEEN'S MYOTIS

Myotis keenii septentrionalis (Trouessart)

[*Vespertilio gryphus*] var. *septentrionalis* Trouessart, Catalogus mammalium . . . , fasc. 1, p. 131, 1897.

Type locality.—Halifax, Nova Scotia, Canada.

General distribution.—Eastern North America, from Newfoundland, Nova Scotia, Quebec, and Ontario, south to northern Florida and west to Manitoba, North and South Dakota, Nebraska, Kansas, and Arkansas.

Distribution in Maryland.—Occurs in all sections of the State, and is common.

Distinguishing characteristics.—This bat is similar in size and color to the little brown myotis (*Myotis lucifugus*), but may be distinguished from that species by its long ears, which extend some 4 to 5 millimeters beyond the tip of the nose when laid forward. The skull is narrower in proportion to its length than that of the little brown myotis.

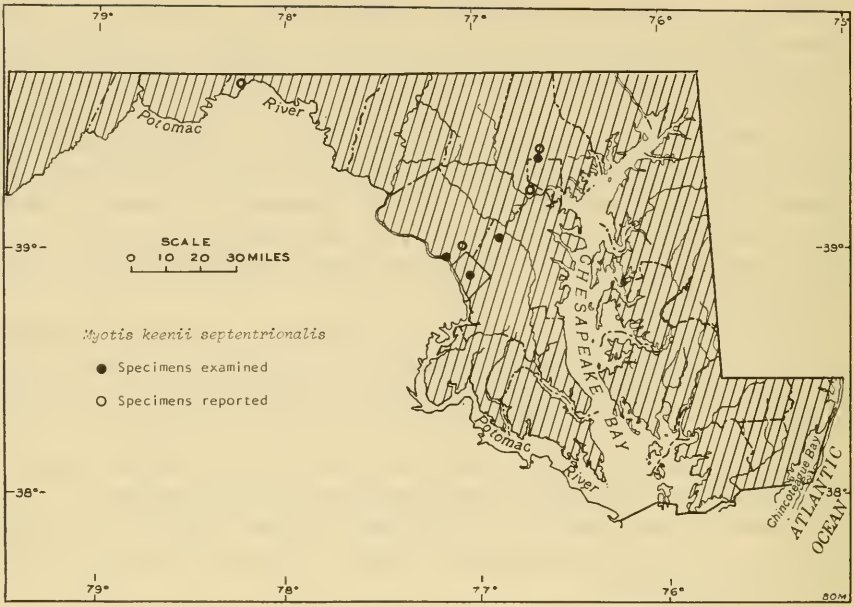

FIGURE 15.—Distribution of *Myotis keenii septentrionalis.*

Measurements.—External measurements of three adults from Plummers Island, Montgomery County, are as follows: Total length 81, 87, 75; tail vertebrae 38, 35, 35; hind foot 9, 9, 10. Some cranial measurements of four adults from Plummers Island are: Greatest length 14.5 (14.4–14.7); zygomatic breadth 8.9 (8.8–9.0); interorbital breadth 3.6 (3.6–3.7); length of maxillary toothrow 5.9 (5.7–6.0).

Habitat and habits.—This species roosts in small colonies in caves, and under loose bark on trees. Frequently it is found in association with the little brown myotis, from which it differs little in habitat selection or habits, except that it seems to be more solitary. Mansueti (1941, pp. 56–57) found one sleeping under the bark of a dead standing tree near Arbutus, Baltimore County. When he peeled the bark away, the bat flew to a nearby tree and crawled up under some loose bark on it. This species is more abundant than the few Maryland records indicate.

Specimens examined.—Baltimore County: Bare Hills, 1. *Montgomery County:* Cabin John Bridge, 1; Plummers Island, 5. *Prince Georges County:* Muirkirk, 1. *District of Columbia:* 4.

Other records and reports.—Baltimore County: Arbutus (Mansueti, 1941); Lake Roland (Bures, 1948: 63). *Montgomery County:* Forest Glen (Miller, 1897: 76). *Washington County:* Round Top Mountain, near Hancock (bat banding record, U.S. Fish and Wildlife Service).

INDIANA MYOTIS

Myotis sodalis Miller and G. M. Allen

Myotis sodalis Miller and G. M. Allen, Bull. U.S. Nat. Mus., 144: 130, 25 May 1928.

Type locality.—Wyandotte Cave, Crawford County, Indiana.

General distribution.—Eastern United States from central New England west to Wisconsin, Missouri, and Arkansas, south into northern Florida. It occurs on the Atlantic Coastal Plain, however, only in the New England area.

Distribution in Maryland.—Apparently very rare in the State. Its distribution is probably limited to limestone caves in the Ridge and Valley and Allegheny Mountain sections.

Distinguishing characteristics.—Resembles *Myotis lucifugus*, but differs in coloration, the fur being a dull grayish chestnut rather than bronze, with the basal portion of the hairs of the back dull lead colored; coloration of underparts pinkish to cinnamon; hind feet smaller and more delicate than in *M. lucifugus*; slight, but well-defined sagittal crest usually present on skull.

Measurements.—Two adults from the type locality in Indiana have measurements as follows: Total length 86, 87; tail vertebrae 35, 38; hind foot 9, 9; greatest length of skull 14.1, 13.9; zygomatic breadth 8.7, 8.3; interorbital breadth 3.8, 3.7; length of maxillary toothrow 5.5, 5.3.

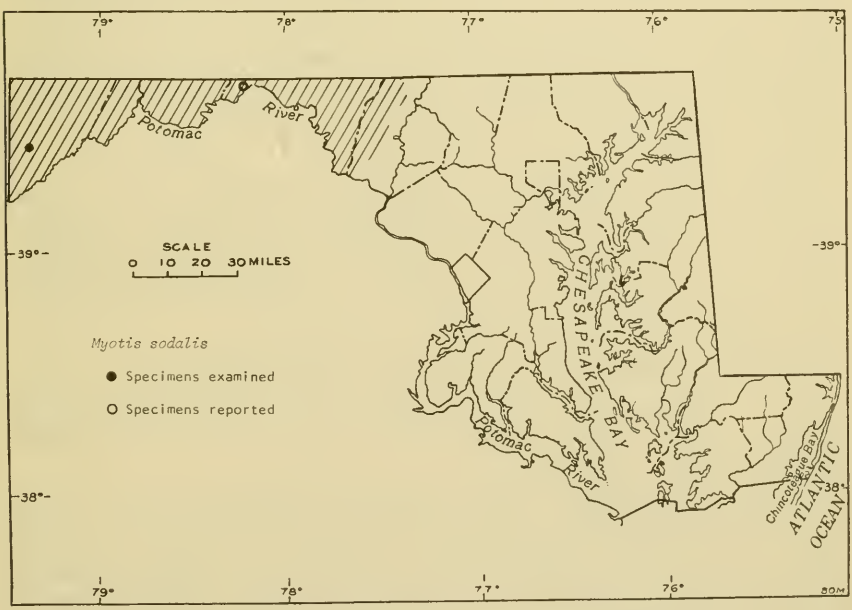

FIGURE 16.—Distribution of *Myotis sodalis*.

The skull of an adult from Oakland, Garrett County, measures: Greatest length 13.7; zygomatic breadth 8.1; interorbital breadth 3.7; length of maxillary toothrow 5.0.

Habitat and habits.—This bat roosts almost exclusively in limestone caves, preferring those in which there are considerable bodies of water. It forms large colonies and is often found in association with *M. lucifugus*. It is known from only 2 localities in Maryland.

Hall (1962) has thoroughly studied the life history of this bat. He found that at Blackball Mine, La Salle County, Ill., the earliest date for entrance into hibernation was 14 September. The major buildup of the hibernating colony was during October and the first part of November. The hibernating colony starts diminishing in early April, and by the first week of June no *sodalis* are in hibernation. He estimates that the average hibernation period for this species would be from 15 October to 20 April, or 187 days. He found that large numbers of Indiana myotis accumulate in a few caves to hibernate, and that for five consecutive winters the species was found in the same seven caves and in no others in Edmondson County, Kentucky. This species also occupies caves during the nonhibernating summer months, and may be considered a true cave species.

As far as movements and migrations are concerned, Hall says that the same individual may be present in one area winter and summer whereas others may move as much as 250 miles between seasons. He says that the few band recoveries indicate that certain movement areas exist for certain populations. For instance, he found that one such population range includes Kentucky, Indiana, Illinois, and southern Ohio, and that no movement takes place between this area and the Ozark area of Arkansas and Missouri.

Little is known regarding the feeding and breeding habits of *M. sodalis*, but probably they are quite similar to those of *M. lucifugus*. Like that species, *M. sodalis* is long-lived. One specimen banded in Carter County, Ky., on 12 March 1950, was recovered in good health 14 years later on 8 January 1964, in the same cave.

Specimens examined.—Garrett County: Near Oakland, 1.

Other records and reports.—Washington County: Round Top Mountain, near Hancock (bat banding record, U.S. Fish and Wildlife Service).

Remarks.—The skull of the Maryland specimen is small in all measures, but otherwise appears to be typical *M. sodalis*. It has the slight but perfectly defined sagittal crest which is generally present in this species and lacking in *M. lucifugus*. Unfortunately, the skin is missing from the National Museum collections.

SMALL-FOOTED MYOTIS

Myotis subulatus leibii (Audubon and Bachman)

Vespertilio leibii Audubon and Bachman, Jour. Acad. Nat. Sci. Philadelphia, ser. 1, 8 : 284, 1842.

Myotis winnemana Nelson, Proc. Biol. Soc. Wash., XXVI: 183, 8 August 1913. (Type from Plummers Island, Maryland.)

Type locality.—Erie County, Ohio.

General distribution.—Ontario and southwestern Quebec, south to western North Carolina, and west to southern Iowa, eastern Kansas, and northeastern Oklahoma.

Distribution in Maryland.—Recorded from Plummers Island, Montgomery County, and Round Top Mountain near Hancock, Washington County. This species probably hibernates in caves in the Allegheny Mountain section, and passes through the rest of the State during migrations.

Distinguishing characteristics.—Similar to *Myotis lucifugus*, but differs in its smaller size, golden tinted fur, black ears, black facial mask, and shorter forearm. The skull is much flatter than that of *M. lucifugus*, and the braincase narrower.

Measurements.—Two adults from Plummers Island, Montgomery County (the first the type of *M. winnemana* Nelson) measure as follows: Total length 82, 80; tail vertebrae 39, 35; hind foot 8, 7; greatest

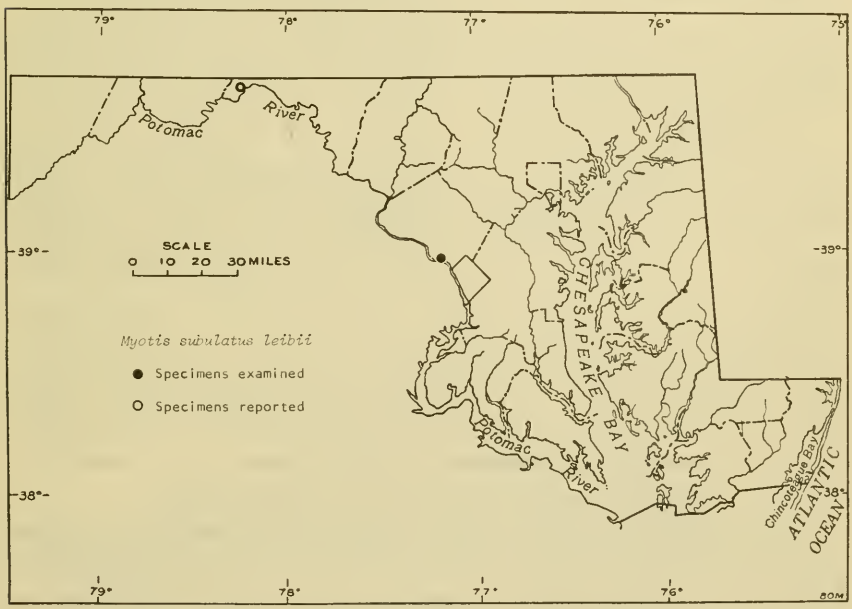

FIGURE 17.—Distribution of *Myotis subulatus leibii*.

length of skull 13.7, 13.1; interorbital breadth 3.4, 3.3; length of maxillary toothrow 5.1, 5.0.

Habitat and habits.—These bats probably hibernate in caves in the wild forested regions of the Allegheny Mountains and migrate elsewhere in the State during late winter and early spring. Most specimens have been taken in caves located in hemlock forests. The position of these bats as they hang on the walls or ceilings of the caves is a definite means of identification. The arms, instead of hanging parallel to the body, as generally found in *M. lucifugus* and other bats, are extended about 30 degrees from the vertical. Little is known of the feeding and breeding habits, but they are presumed to be similar to *M. lucifugus.*

Specimens examined.—Montgomery County: Plummers Island, 2.

Other records and reports.—Washington County: Round Top Mountain, near Hancock (bat banding record, U.S. Fish and Wildlife Service).

SILVER-HAIRED BAT

Lasionycteris noctivagans (Le Conte)

V[espertilio]. noctivagans Le Conte, in McMurtrie, The animal kingdom . . . by the Baron Cuvier, vol. 1, App., p. 431, 1831.

Type locality.—Eastern United States.

General distribution.—Nearly all of North America, from the tree line in northern Canada, south to Georgia, Texas, New Mexico, and California.

Distribution in Maryland.—Probably breeds only in the Allegheny Mountain section, but occurs in all sections of the State as a migrant in the spring and the fall.

Distinguishing characteristics.—Teeth 2/3, 1/1, 2/3, 3/3, = 36; pelage dark brownish-black, the ends of the hairs tipped with silver, giving a somewhat frosted effect, particularly along the middle of the back; fur extends onto dorsal surface of interfemoral membrane; ears short and rounded with broad, blunt tragus; skull flattened, and rostrum broad.

Measurements.—An adult male from Plummers Island, Montgomery County has the following external measurements: Total length 116; tail vertebrae 47; hind foot 10. Some cranial measurements of four adults from Washington, D.C. are: Greatest length 15.8 (15.6–16.2); zygomatic breadth (2 specimens) 9.9, 9.1; interorbital breadth 4.1 (4.0–4.3); length of maxillary toothrow 5.7 (5.6–5.8).

Habitat and habits.—This bat is found most frequently flying about ponds and streams in wooded areas. It roosts in hollow trees, in dense foliage, and occasionally in buildings. It is sociable and often encountered in large groups. As in many species of bats, there is a marked

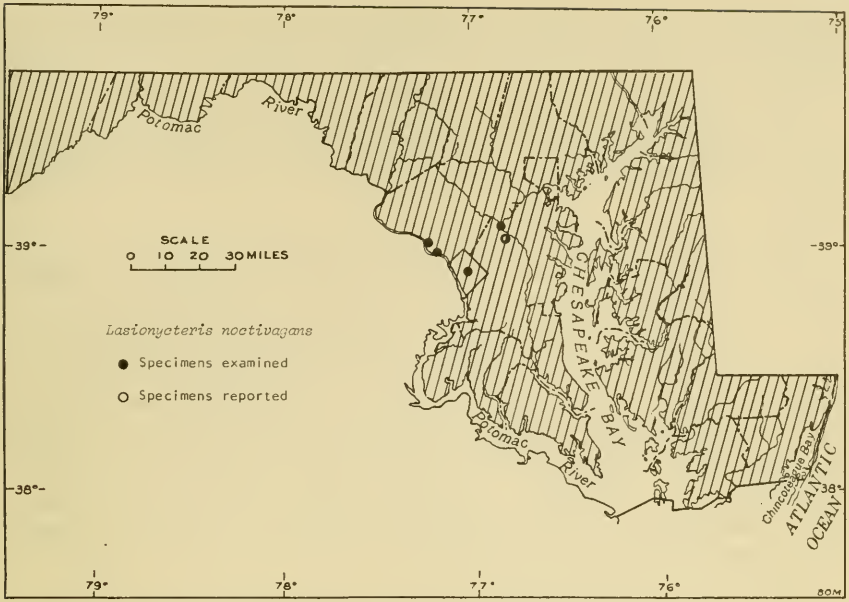

FIGURE 18.—Distribution of *Lasionycteris noctivagans.*

segregation of the sexes and the large colonies seem to be composed primarily of females. Solitary animals are usually males.

The breeding habits of this species are not well known, but according to Jackson (1961, p. 86) it usually has two young, born blind and nearly naked, the last part of June or early in July. The young remain clinging to the breast of the mother until they are about 3 weeks old, when they are able to fly and shift for themselves. A single litter is produced each year.

The silver-haired bat feeds entirely on nocturnal insects, particularly those that fly high in the woodlands or over the borders of watercourses with wooded banks.

Specimens examined.—Montgomery County: Great Falls, 1; Plummers Island, 1. *Prince Georges County:* Laurel, 1. *District of Columbia:* 5.

Other records and reports.—Prince Georges County: Patuxent Research Center (Gardner, 1950*b*, p. 112).

EASTERN PIPISTRELLE

Pipistrellus subflavus subflavus (F. Cuvier)

V[*espertilio*]. *subflavus* F. Cuvier, Nouv. Ann. Mus. Hist. Nat. Paris, 1: 17, 1832.

Type locality.—Georgia, restricted to the LeConte Plantation, 3 miles SW Riceboro, Liberty County, by Davis (1959, p. 522).

General distribution.—From central Minnesota and southern Quebec south into Georgia and western Florida; west to Oklahoma, Texas, and Tamaulipas. The center of its abundance is the Ohio River Valley; north of this it occurs locally in summer (Davis and Mumford, 1962, p. 396).

Distribution in Maryland.—Probably ranges throughout all sections of the State, although there are no records of it from the Eastern Shore section.

Distinguishing characteristics.—Teeth 2/3, 1/1, 2/2, 3/3, = 34; smallest bat in Maryland; coloration of dorsum grayish to reddish-brown, each hair tricolored, plumbeous at base, dark brown at tip, with central portion yellowish-brown; flight weak and erratic, giving the animal somewhat the appearance of a large fluttering moth.

Measurements.—External measurements of 11 adults from Washington, D.C., are as follows: Total length 81.6 (75–90); tail 39.5 (37–42); hind foot 8.5 (8.0–9.0). Some cranial measurements of 10 adults from Washington are as follows: Greatest length 12.8 (12.4–13.1); zygomatic breadth 7.9 (7.7–8.2); interorbital breadth 3.5 (3.4–3.6); length of maxillary toothrow 4.3 (4.2–4.4).

Habitat and habits.—This is a wide-ranging species that hibernates in caves, mine shafts, and rock crevices. During the summer months it probably spends the daylight hours in trees, although it is sometimes found in buildings. It is most frequently encountered in wooded areas near water. The pipistrelle is believed to have a feeding range of at least 5 or 6 miles, and a homing instinct has been demonstrated by tracing banded bats for distances up to 80 miles. Individuals roost year after year in the same cave.

Mating occurs in November, and young are born the last part of June or early July. Usually two constitute a litter, but there are occasionally triplets, and sometimes only a single offspring. By the time they are about a month old they are able to fly, and shortly thereafter begin to shift for themselves. Since pipistrelles are so small their food is probably restricted to insects such as flies, moths, and the smaller bugs and beetles.

Despite their diminutive size, pipistrelles apparently have a long life span. Banded individuals have been recovered in good health as long as 10 years after they were originally tagged.

Specimens examined.—Anne Arundel County: Magatha R. (= Magothy River?), 2. *Charles County:* Marshall Hall, 13. *Garrett County:* Near Oakland, 1. *Montgomery County:* Capitol View, 1; Glen Echo, 1; Great Falls, 1; Plummers Island, 2. *Prince Georges County:* Hyattsville, 1; Laurel, 1; near D. C. line, 6. *St. Marys County:* St. George Island, 4; *District of Columbia:* 40.

Other records and reports.—Baltimore County: Bare Hills (Bures, 1948: 64); Orange Grove (Hampe, 1939: 5). *Washington County:*

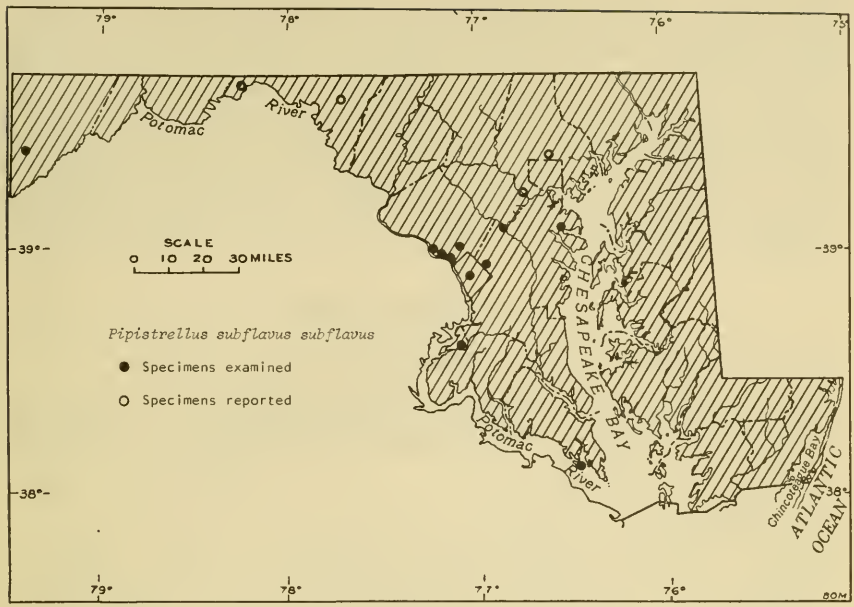

FIGURE 19.—Distribution of *Pipistrellus subflavus subflavus.*

Keedysville, Snively's Cave No. 1 (bat banding record, U.S. Fish and Wildlife Service); Round Top Mountain (bat banding record, U.S. Fish and Wildlife Service).

Remarks.—Two subspecies of *Pipistrellus subflavus* have been named from the eastern United States, *P. s. subflavus*, the typical form as described above, and *P. s. obscurus* Miller (Type locality: Lake George, Warren County, New York). Miller (1897, p. 93) described *obscurus* as differing from *subflavus* only in coloration, being somewhat darker, duller, and more yellowish. Several specimens from the vicinity of Washington, D.C., in the national collections, are darker than typical *P. s. subflavus* and were referred by Bailey (1923, p. 136) and Gardner (1950b, p. 112) to *obscurus*. Bailey (1923, p. 137) says that "They may have migrated from their northern habitat, or merely wandered out of their regular range after the breeding season was over." As pointed out by W. H. Davis (1959, p. 523), who has synonomyzed *P. s. obscurus* with *P. s. subflavus*, there is a wide range of individual variation in color in this species, and dark specimens are found throughout the entire range of *P. s. subflavus*. The dark specimens from the vicinity of Washington, referred to *obscurus* by both Bailey and Gardner, fall within the range of individual variation of color in the subspecies *subflavus*.

Another Maryland specimen which exhibits atypical coloration is from St. George Island, St. Marys County. It is similar to *P. s. florid-*

anus Davis, which is distributed over peninsular Florida and southeastern Georgia. W. H. Davis (1957, p. 215) speculated that perhaps this animal actually was a *floridanus* that had wandered northward. In a later publication (1959, p. 524), however, he says that unless it can be shown that this actually happened it is best to refer this specimen to *P. s. subflavus*. The specimen has been in the National collections for many years (collected 20 August 1887), and the unusual coloration is perhaps due to fading.

BIG BROWN BAT

Eptesicus fuscus fuscus (Palisot de Beauvois)

Vespertilio fuscus Palisot de Beauvois, Catalogue Raisonné du Muséum de Mr. C. W. Peale, Philadelphia, p. 18 (p. 14 of English ed. by Peale and Beauvois), 1796.

Type locality.—Philadelphia, Pa.

General distribution.—Eastern North America, from Quebec, Ontario, and Manitoba, south into Florida and Nuevo León, México.

Distribution in Maryland.—Abundant in the lower Piedmont and upper Western Shore sections in the vicinity of the fall line. Uncommon in the Allegheny Mountain, Ridge and Valley, and Eastern Shore sections.

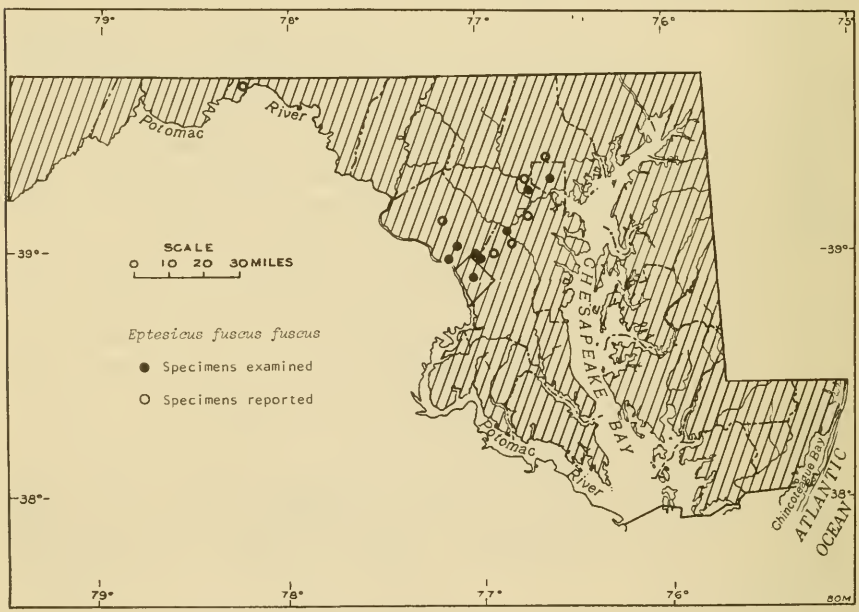

FIGURE 20.—Distribution of *Eptesicus fuscus fuscus*.

Distinguishing characteristics.—Teeth 2/3, 1/1, 1/2, 3/3, = 32; size large, exceeded in Maryland only by the hoary bat; coloration uniformly dark brown; ears thick and heavy, somewhat rounded and medium in size, naked except for some fur at the base; wings and interfemoral membrane lacking fur; skull larger and heavier than any other local bat except *Lasiurus cinereus*, from which it differs in being noticeably narrower. Both *Eptesicus* and *Lasiurus* have 32 teeth, but in *Eptesicus* there are 2 upper incisors and 1 upper premolar, while in *Lasiurus* there are 2 upper premolars and 1 upper incisor on each side.

Measurements.—External and cranial measurements of 15 adults from Washington, D.C., are as follows: Total length 113.2 (110–122); tail 43.6 (40–48); hind foot (average of 9) 12 (10–13); greatest length of skull 18.5 (17.5–19.6); zygomatic breadth (average of 10) 12.6 (12.1–13.4); interorbital breadth 4.2 (3.9–4.5); length of maxillary toothrow 7.1 (6.9–7.4).

Habitat and habits.—This bat usually occurs around buildings and dwellings where it roosts in the daytime under windowsills, in the eaves of roofs, in cracks or crevices, or behind doors, blinds, and awnings. It is sometimes found in hollow trees, under loose bark, and occasionally in caves or crevices in cliffs. This species is common in parts of Maryland; it is an unusual year when at least one specimen is not captured in the Natural History building of the National Museum and added to the study collection. The big brown bat does not form large colonies as do some species of bats. Probably it is in part migratory, but does not engage in extensive seasonal migrations, other than to find a suitable place for hibernation. This is one of the last bats to hibernate in the fall, and it is on wing again in early March. During mild spells of winter it may be seen flying in the sun at midday (Hamilton, 1943, p. 90). These bats are long-lived; records of banded animals recovered 10 to 15 years later are numerous.

The homing instinct seems to be developed to some degree. Cohen (1944) found several adults behind the shutter of a house in Berwyn, Prince Georges County, and after banding them released them on 4 October 1941, in Baltimore City. Twelve days later, on 15 October 1941, one of these bats was found hanging on the same shutter from which it had been removed in Berwyn. It had travelled a distance of 26.56 miles, over the congested city of Baltimore, and heavily travelled highways, to return to its home roost.

The mating season for the big brown bat is September, and young are born the following June. Normally two comprise a litter, although there may occasionally be only one. The young grow rapidly and 3 or 4 weeks after birth are able to shift for themselves.

This species, like all Maryland bats, is primarily insectivorous. Hamilton (1933a) examined 2,200 summer fecal pellets from northern

West Virginia and concluded that the most common insects consumed by the big brown bat in summer are (in order of abundance of remains): Coleoptera, Hymenoptera, Diptera, Plecotera, Ephemirida, Hemiptera, Tricoptera, Neuroptera, Mecotera and Northoptera. No lepidopterous remains were discovered by Hamilton in the pellets.

Specimens examined.—Baltimore City: 1. *Baltimore County:* Catonsville, 1. *Montgomery County:* Kensington, 1; Plummers Island, 2; Silver Spring, 1; Takoma Park, 2. *Prince Georges County:* Laurel, 3. *District of Columbia:* 86.

Other records and reports.—Anne Arundel County: Jessup (Silver, 1928, p. 149). *Baltimore County:* Bare Hills (Cohen, 1942, p. 96); Patapsco State Park (Hampe, 1939, p. 5). *Montgomery County:* Washington Grove (Christian, 1956, p. 66). *Prince Georges County:* Berwyn (Cohen, 1944, p. 65); Patuxent Research Center (Gardner, 1950*b*, p. 112). *Washington County:* Round Top Mountain, near Hancock (banding record).

RED BAT

Lasiurus borealis borealis (Müller)

Vespertilio borealis Müller, Des Ritters Carl von Linne . . . vollständiges Natursystem nach der zwolften lateinischen Ausgabe. . . . Suppl. (Mammalia), p. 20, 1776.

Type locality.—New York

General distribution.—Eastern North America, from southern New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, and Alberta, south to Florida and Texas.

Distribution in Maryland.—Abundant in all sections of the State.

Distinguishing characteristics.—Teeth 1/3, 1/1, 2/2, 3/3, = 32; size medium; color bright rufous or fulvous, hairs plumbeous at base and whitish at tips, producing a slight frosted effect; ears broad and blunt, rounded at tip, reaching about halfway from the angle of the mouth to the nostril when laid forward; tail moderately long; interfemoral membrane thickly furred on upper surface.

This bat is easily distinguished from all other bats in Maryland by its bright rufous coloration and the furred interfemoral membrane. Males generally are darker and more reddish than females.

Measurements.—An adult male from Doubs, Frederick County, and an adult female from 3 miles NW of Annapolis, Anne Arundel County, measure respectively: Total length 109, 113; tail 49, 50; hind foot 10, 7; greatest length of skull 13.0, 12.6; zygomatic breadth 9.5, 9.5; interorbital breadth 4.4, 4.2; length of maxillary toothrow 4.5, 4.4.

Habitat and habits.—This bat shows a preference for deciduous woodlands, orchards, and city parks with trees and tall shrubs. It generally chooses the branch of a shady tree in which to roost, some-

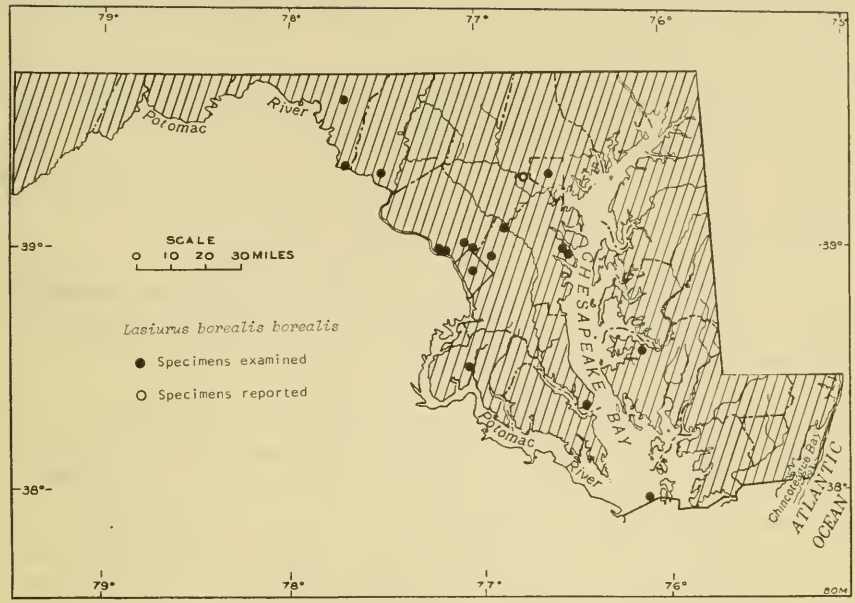

FIGURE 21.—Distribution of *Lasiurus borealis borealis.*

times within a few feet of the ground, and conceals itself in the foliage.

It is well known that the red bat is migratory in habits, spending summers in northern areas and flying south in the autumn. They are not found in the winter in the more northern areas, while their numbers appear to increase in the south. In Maryland they apparently occur the year round, specimens having been taken in all months from April through December, and in nearby Arlington, Va., on 1 March. Whether the same population occurs here in the summer as in the winter is not known. Perhaps the summer population migrates farther south and its place is taken by a more northern population which has migrated in.

It appears that this bat migrates southward in the fall behind an advancing cold front. David Bridge, a Maryland bird bander, tells me that he often takes red bats in the autumn in his bird nets at Kent Point on Kent Island, Queen Annes County, for several days following the movement of a cold front through the area.

The red bat is a strong swift flyer. Jackson (1961, p. 96) states that observational timing he made of it would indicate an ordinary straightaway flying speed of near 40 miles per hour. It has sometimes been observed flying far out to sea as much as 500 miles from the nearest land. Usually it migrates at night, but occasionally it is observed during the day. A. H. Howell (1908, p. 36) observed over a

hundred bats, most of which were probably of this species, passing over a part of Washington, D.C., between 9 and 10 a.m. on the cloudy mild morning of 28 September 1907.

Red bats mate during early August; copulation occurs while the bats are in flight. The female apparently stores the sperm, and the young are not born until the following June after a gestation period of 80 to 90 days. Three are the usual number of young per litter, although there are occasionally two or four.

Like other Maryland bats, the red bat is insectivorous and catches most of its prey while on wing. Some insects, however, are probably taken from the foliage or even near the ground, since remains of crickets have been found in stomachs. Additional items of diet are flies, bugs, beetles, cicadas, and other insects.

Specimens examined.—Anne Arundel County: Annapolis, 1; Annapolis, 3 miles NW, 1; no exact locality, 2. *Baltimore City:* 1. *Calvert County:* Solomons, 1. *Charles County:* Port Tobacco, 1½ miles SW, 2. *Dorchester County:* Cambridge, 1. *Frederick County:* Doubs, 1. *Montgomery County:* Forest Glen, 6; Glen Echo, 1; Plummers Island, 7; Silver Spring, 2. *Prince Georges County:* College Park, 1; Laurel, 14. *Somerset County:* off Tangier Island, Virginia, 1; *Washington County:* Hagerstown, 2; Sandy Hook, 1. *District of Columbia:* 83.

Other records and reports.—Baltimore County: Patapsco State Park (Hampe, 1939, p. 5). *Queen Annes County: Kent Point* (bird bander David Bridge in verbis, 16 September 1964).

Remarks.—A closely related species, the seminole bat, *Lasiurus seminolus* (Rhoads), which normally is found in Florida, southern Georgia, Alabama, Mississippi, and Louisiana, has been reported twice from southeastern Pennsylvania (Poole, 1932, p. 162; 1949, p. 80) and once from central New York (Layne, 1955, p. 453). Layne suggests that individuals of this species may wander northward far out of the normal range in summer, and if this is so, the seminole bat may eventually be taken in Maryland. This species is distinguished from the red bat by its much darker coloration, a rich mahogany brown slightly frosted with white.

HOARY BAT

Lasiurus cinereus cinereus (Palisot de Beauvois)

Vespertilio cinereus (misspelled *linereus*) Palisot de Beauvois, Catalogue raisonné du muséum de Mr. C. W. Peale, Philadelphia, p. 18, 1796.

Type locality.—Philadelphia, Pa.

General distribution.—Most of North America, from the Atlantic to the Pacific, north into Canada, and south into Mexico. Breeds in the northern part of its range, mostly north of the United States.

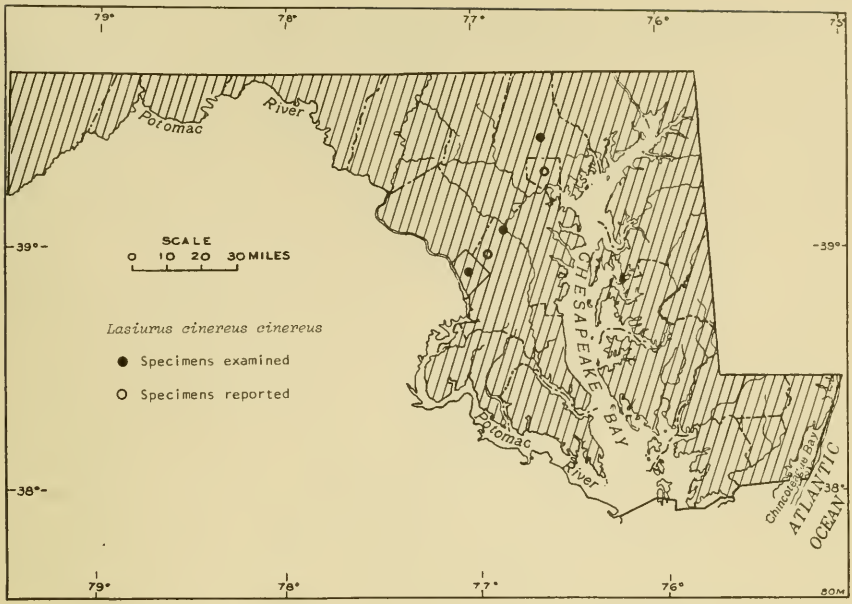

FIGURE 22.—Distribution of *Lasiurus cinereus cinereus*.

Distribution in Maryland.—Occurs as a migrant in all sections of the State; may breed in the higher portions of the Allegheny Mountain section.

Distinguishing characteristics.—Teeth as in *L. borealis;* size large (averaging 135 mm in total length); wingspread averaging around 14 inches; coloration a mixture of grayish umber and chocolate brown, heavily tinged with white, so as to produce a hoary effect, especially on the back; head blunt, with ears large and rounded, conspicuously rimmed with black or dark brown; tail medium length, about 40 percent of total length of the animal; interfemoral membrane thickly furred on upper surface nearly to the edge; anterior edge of underside of wing furred for about half its length. This bat is easily distinguished from all other Maryland bats by its large size and unique coloration.

Measurements.—Measurements of an adult male from Washington, D.C., are as follows: Total length 135.5; tail 61.5; hind foot 13; greatest length of skull 16.1; zygomatic breadth 12.0; interorbital breadth 4.9; length of maxillary toothrow 6.2.

An adult female from Washington, D.C., has the following cranial measurements: Greatest length of skull 16.9; zygomatic breadth 12.7; interorbital breadth 5.5; length of maxillary toothrow 6.2.

Habitat and habits.—This is a migratory species. It breeds and spends the summer in the northern part of its range, from southeast-

ern Pennsylvania and possibly the higher mountains of the Appalachians, north into Canada. It migrates southward quite late in the season. It prefers to roost in coniferous forests, but may also be found in farmyards, city parks, and yards, particularly where coniferous trees are growing. The hoary bat has an extensive home range and may fly a mile or more from its roosting site in search of food. It is a strong and rapid flyer, and Jackson (1961, p. 100) estimates that it can achieve speeds of up to 60 miles an hour. The scarcity of records and specimens from Maryland indicates that it is rare here. In the summer, it occurs in the higher mountains of the Allegheny Mountain section. In other seasons, it may be encountered throughout Maryland.

Little is known of the breeding habits of this bat. Jackson (1961, pp. 100–101) says that mating probably occurs in September or October and the young are born in May or June, thus giving an apparent gestation period of about 8 months. It seems probable, however, that as in some other species of bats spermatozoa survive in the uterus through the winter, and that fertilization takes place early in the spring, giving an actual gestation period of about 90 days. Usually, two young comprise a litter, although it is possible that as many as four may be produced.

The hoary bat is primarily an insect feeder, but occasionally preys on smaller bats.

Specimens examined.—Baltimore County: Cockeysville, 1. *Prince Georges County:* Laurel, 1. *District of Columbia:* 3.

Other records and reports.—Baltimore City (Merriam, 1887, p. 86). *Prince Georges County:* Berwyn (Tromba, 1954, p. 253).

EVENING BAT

Nycticeius humeralis humeralis (Rafinesque)

Vespertilio humeralis Rafinesque, American Monthly Mag., 3 (6) : 445, October 1818.

Type locality.—Kentucky.

General distribution.—From Pennsylvania, Michigan, and Illinois, south into Florida and Texas, and west into eastern Oklahoma and Kansas.

Distribution in Maryland.—Probably absent in the higher mountains of the Allegheny Mountain and Ridge and Valley sections, but elsewhere it may occur sparingly as a summer resident.

Distinguishing characteristics.—Teeth 1/3, 1/1, 1/2, 3/3, = 30; superficially resembles *Myotis* but can be easily distinguished by the reduced number of teeth and the short sparse brown fur which is dull umber above and plumbeous at the base; fur on abdomen paler than on dorsum; ears small and thick. The young of this species are considerably darker than the adults.

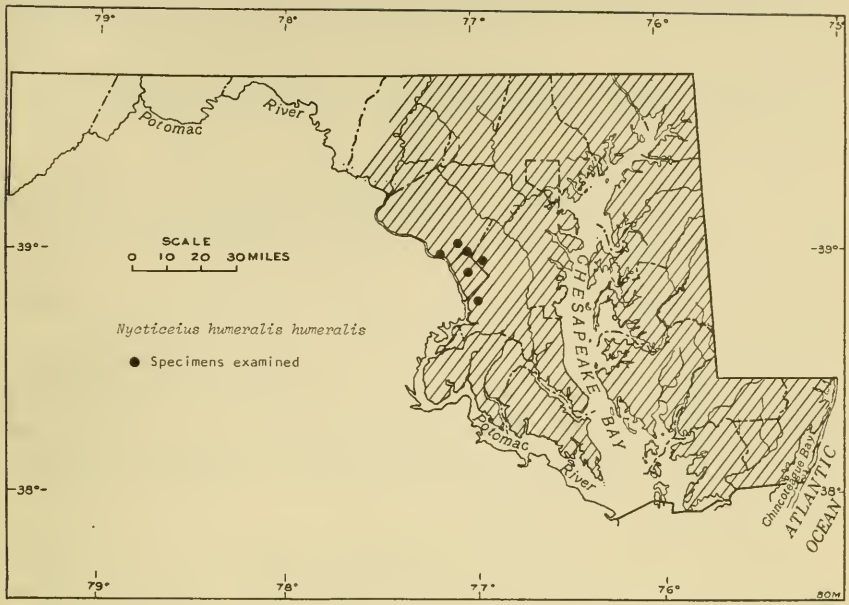

FIGURE 23.—Distribution of *Nycticeius humeralis humeralis.*

Measurements.—Three adults from the vicinity of Washington, D.C., have external measurements as follows: Total length 90, 95, 94; tail 39, 35, 35; hind foot 10, 9, 8. Six adults from the vicinity of Washington have the following cranial measurements: Greatest length 14.2 (13.7–15.5); zygomatic breath 9.7 (9.6–10.0); interorbital breadth 3.9 (3.8–4.0); maxillary toothrow 5.2 (5.0–5.4).

Habitat and habits.—This is essentially a southern species that wanders north in summer sometimes as far as Pennsylvania, Michigan, and Illinois. It prefers to roost in hollow trees, flying out with a slow and steady flight as darkness falls. It gives birth to two young, generally in late May. Little else is known of its habits or life history.

Specimens examined.—Montgomery County: Linden, 1; Plummers Island, 1; Silver Spring, 1. *Prince Georges County:* Hyattsville, 2; Oxon Hill, 1; near D.C. line, 1. *District of Columbia:* 6.

(BIG-EARED BAT)

Plecotus townsendii virginianus (Handley)

Corynorhynus virginianus Handley, Jour. Washington Acad. Sci., 45 (2) : 148, 23 May 1955.

Type locality.—Schoolhouse Cave, 4.4 miles NE of Riverton, 2,205 feet, Pendleton County, W. Va.

General distribution.—Central part of the Appalachian highlands in eastern Kentucky, western Virginia, and eastern West Virginia.

Distribution in Maryland.—Not as yet recorded, but should be looked for in the higher portions of the Allegheny Mountain section. To date it has not been found resident in any Maryland caves, but it probably enters the State on feeding forays from caves in nearby West Virginia and Virginia.

Distinguishing characteristics.—Teeth 2/3, 1/1, 2/3, 3/3, = 36, ears very long; glandular masses on nose appear as lumps; fur long and limp; colored a dark brown above, and pinkish buff on belly, interfemoral membrane naked.

The very large ears serve to distinguish this bat from any others that may be encountered within Maryland.

Measurements.—Handley (1959, p. 233) gives some measurements of a series of adults from West Virginia as follows: Total length 101 (98–103); tail vertebrae 50 (48–52); hind foot 11 (10–12); ear from notch 34 (31–38); greatest length of skull 16.5 (16.2–16.8); zygomatic breadth 8.8 (8.6–9.0); interorbital breadth 3.7 (3.6–3.9); length of maxillary toothrow 5.3 (5.2–5.4).

Habitat and habits.—This is a true cave bat usually roosting in small groups and emerging at dusk to fly at considerable heights. After dusk it descends nearer the ground, sometimes at an elevation of only several feet, searching for insect prey. When roosting in the caves during the day, the long ears are spirally coiled and flattened against the neck. It is a shy bat, quick to take alarm. With its large ears, it can detect the least sound and seems to be more wary than other species.

Although Pearson et al. (1952) have made a detailed study of the life history of the western subspecies of *Plecotus townsendii*, little is known concerning the habits of the eastern race. Since the two are widely separated geographically, much of Pearson's findings may not be applicable to the eastern form. Hamilton (1943, pp. 102–103) says that the eastern race bears its young during late June and that the mother carries the single offspring until it becomes too heavy. As with other vespertilionid bats, the spermatozoa are probably stored over winter in the uteri of the females and are capable of fertilizing in the spring.

This species is insectivorous, and Hamilton (1943, p. 104) says that those examined for a clue to their feeding habits contained only the remains of Lepidoptera in their stomachs.

Remarks.—This bat has never been taken within Maryland, but has been found in several caves very close to the border of the western part of the State, in Grant, Preston, and Tucker Counties, W. Va.

During the Pleistocene, a bat very similar to this species did inhabit Maryland caves. Gidley and Gazin (1933, p. 345) described *Corynorhynus alleganiensis* (=*Plecotus alleganiensis*) from Pleistocene deposits in Cumberland Cave, Allegany County, Md. Handley (1959, p.

210) states that *P. alleganiensis* was similar in many respects to (and possibly directly ancestral to) *P. townsendii.*

Order LAGOMORPHA (rabbits, hares, etc.)

Family LEPORIDAE (rabbits, hares)

EASTERN COTTONTAIL

Sylvilagus floridanus mallurus (Thomas)

L[epus]. n[uttalli]. mallurus Thomas, Ann. Mag. Nat. Hist., ser. 7, 2: 320, October 1898.

Type locality.—Raleigh, N.C.

General distribution.—Primarily east of the Appalachian Mountains, from Massachusetts, south into central Florida, west to Tennessee and Alabama.

Distribution in Maryland.—Occurs abundantly in all sections of the State. Cottontails have been introduced into parts of Maryland from areas outside the range of *mallurus*, and hence all population in the State may not be referrable to that race.

Distinguishing characteristics.—Teeth 2/1, 0/0, 3/2, 3/3, = 28; size small; ears large, pelage long and coarse, reddish brown, mixed with black on the dorsum; underparts white, including the underside of the tail; nape and legs cinnamon-rufous. This species differs from the New England cottontail (*S. transitionalis*), which has not yet been taken in Maryland but which probably occurs in the mountains of the western part of the State, in several external and cranial characters which are described under that species.

Measurements.—External measurements of three adults from the three adults from Washington, D.C., are: Basilar length 57.5, 57.0, 458; tail 60, 64, 75; hind foot 99, 84, ——. Cranial measurements of three adults from Washington D.C., are: Basilar length 57.5, 57.0, 56.5; zygomatic breadth 36.9, 36.5, 36.3; interorbital breadth 19.1, 18.5, 17.9; length of maxillary toothrow 14.1, 14.0, 13.2.

Habitat and habits.—This rabbit occupies a variety of habitats from the marshes of the Delmarva Peninsula to the fields and meadows of western Maryland. It is seldom encountered in heavy woods. It occurs on Assateague Island, off the Atlantic coast of Maryland, where it is particularly abundant in the wooded thickets and dry sandy areas adjacent to the marshes. These rabbits are found in the tall grass and thickets in villages and towns and even in the large cities such as Baltimore and Washington. The summer food consists of almost any type of green vegetation, but it seems to be especially fond of legumes, dandelions, plantains, and lettuce. During winter it eats tender parts of many shrubs and trees and will gnaw away the bark of some species of

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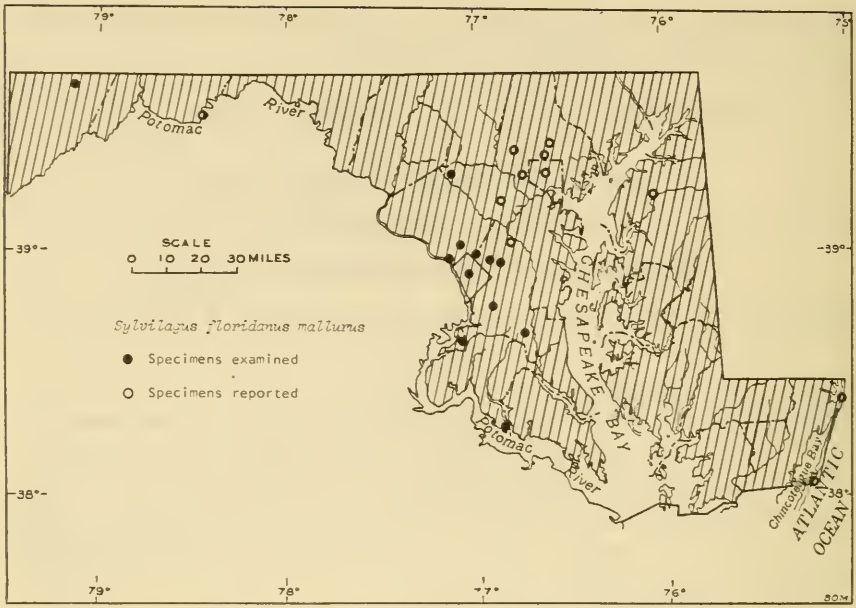

FIGURE 24.—Distribution of *Sylvilagus floridanus mallurus*.

trees. With the deforestation of much of Maryland since Colonial times the cottontail has found more suitable habitat and today is abundant throughout the State.

The cottontail is both diurnal and nocturnal, but is most active during the first 3 or 4 hours after daylight and from 2 to 3 hours before sunset to about 1 hour after sunset. It does not hibernate, but is active yearlong. Cottontails are solitary and seldom are two or more found together except in the case of mother and young.

The female builds a brood nest of grass combined with fur plucked from her own abdomen. The nest, placed in a depression in the ground, is about 4 or 5 inches in diameter and depth. It is usually well concealed in grass, weeds, thickets, or scrubby woods. In addition to the brood nest, the cottontail makes forms that are used as hiding or resting places. These forms are made by scratching or trampling a shallow oval hollow in the ground and sometimes lining it with grass, leaves, or fur.

Cottontails in Maryland mate in late winter. The gestation period varies from 28 to 32 days, and the first litter of the year appears by mid-March. Two or three litters are produced each season, and the number of young per litter varies from three to six, with five being the most frequent.

Specimens examined.—Charles County: Marshall Hall, 1; Rock Point, 1. *Garrett County:* Grantsville, 1. *Howard County:* Long Cor-

ner, 2. *Montgomery County:* Kensington, 1; Plummers Island, 2; Takoma Park, 1; no exact locality, 1. *Prince Georges County:* Clinton, 1; East Riverdale, 1; Lanham, 1; Westwood, 1; no exact locality, 3. *District of Columbia:* 24 (many of these are labeled "purchased in Washington Market" and were probably taken outside the District of Columbia area).

Other records and reports.—Allegany County: Oldtown, 9 miles E (personal observation). *Baltimore City:* (personal observation). *Baltimore County:* Bare Hills–Lake Roland area (Bures, 1948, p. 68); Loch Raven (Kolb, 1938); Gwynnbrook State Game Farm (Sheffer, 1957, p. 90); Patapsco State Park (Hampe, 1939, p. 7). *Howard County:* Atholton (personal observation). *Kent County:* Chestertown (U.S. Fish and Wildlife Service files). *Prince Georges County:* Patuxent Research Center (Herman and Warbach, 1956, p. 85). *Worcester County:* Assateague Island, near the Virginia border (personal observation); Ocean City, 1 mile N (personal observation).

Remarks.—Nelson (1909, p. 168) considers the specimen from Grantsville in the extreme western Allegheny Mountain section to be a distinct intergrade with *S. f. mearnsi*, nearly pale enough to be classified with *mearnsi*.

(NEW ENGLAND COTTONTAIL)

Sylvilagus transitionalis (Bangs)

Lepus sylvaticus transitionalis Bangs, Proc. Boston Soc. Nat. Hist., XXVI, pp. 405–407, 31 January 1895.

Type locality.—Liberty Hill, New London County, Conn.

General distribution—Distributed from southeastern Maine, southern New Hampshire, and Vermont, south through eastern New York, New Jersey, and eastern Pennsylvania and along the Allegheny Mountains through West Virginia to northern Georgia and northeastern Alabama.

Distribution in Maryland.—There are no valid records of the New England cottontail from Maryland, but it almost certainly occurs in the Allegheny Mountain section at higher elevations.

Distinguishing characteristics.—Similar in coloration to the eastern cottontail, except that the underfur is a much darker gray. The back is ochraceous buff, overlaid with a wash of black-tipped guard hairs which give it a dark appearance. The ears are short and round and have a black margin on the outside edge, making a distinct black line which does not blend gradually into the browner color of the ear as in the eastern cottontail. A definite black patch is between and just in front of the ears.

Cranially this species differs from the eastern cottontail in that the skull is lighter and slenderer, the interorbital breadth narrower, and

the rostrum thinner. The supraorbital process is very slender, narrowing anteriorly so that the notch is absent, or virtually so. The posterior portion of the process is very narrow and in some instances is free of the skull, leaving a distinct foramen. The auditory bullae are noticeably smaller in this species than in *S. floridanus*.

Measurements.—Nelson (1909, p. 168) gives average measurements of five adults from Wilmington, Mass., as follows: Total length 388; tail vertebrae 39; hind foot 96; basilar length of skull 54.8; interorbital breadth 17.1.

Since geographic variation appears to be slight in this species, Maryland specimens, if taken, probably would not differ greatly in size from the Massachusetts series.

Habitat and habits.—Llewellyn and Handley (1945, p. 384) say that in Virginia

> All specimens examined were taken at elevations above 3,000 feet in the Allegheny Mountains. Signs indicate that these cottontails occupy the woods and brush along most of the higher crests and ridges of the state.

They believe that the species will be found in Virginia only at elevations above 3,000 feet. Since the species occurs in the Alleghenies to the north and south of Maryland, and since there are several mountains in western Maryland that exceed 3,000 feet in altitude, it is almost certain that the New England cottontail is resident in Maryland and will eventually be taken there.

This species is similar to *Sylvilagus floridanus* with regard to breeding habits and food preferences.

Remarks.—The records of Nelson (1909, p. 199) for the occurrence of the New England cottontail in Washington, D.C., and in nearby Alexandria, Va., have been shown by Bailey (1923, pp. 120–121) to be erroneous. He says:

> They have been recorded from the District . . . and from Alexandria, but the record based on 2 young taken in a nest in the Soldiers Home grounds by Dr. C. W. Richmond on 20 June 1886 was erroneously included under this species, and a specimen which I bought on 1 January 1904 of a colored man on the street who said he killed it at Alexandria, probably came from West Virginia where they are common and are often included in shipments of rabbits to market.

SNOWSHOE RABBIT

Lepus americanus virginianus Harlan

Lepus virginianus Harlan, Fauna Americana, p. 196, 1825.

Type locality.—Blue Mountains, near Harrisburg, Pa.

General distribution.—Southern Ontario, and northeastern United States, from southern Maine, south in the Appalachian Mountains to North Carolina and Tennessee.

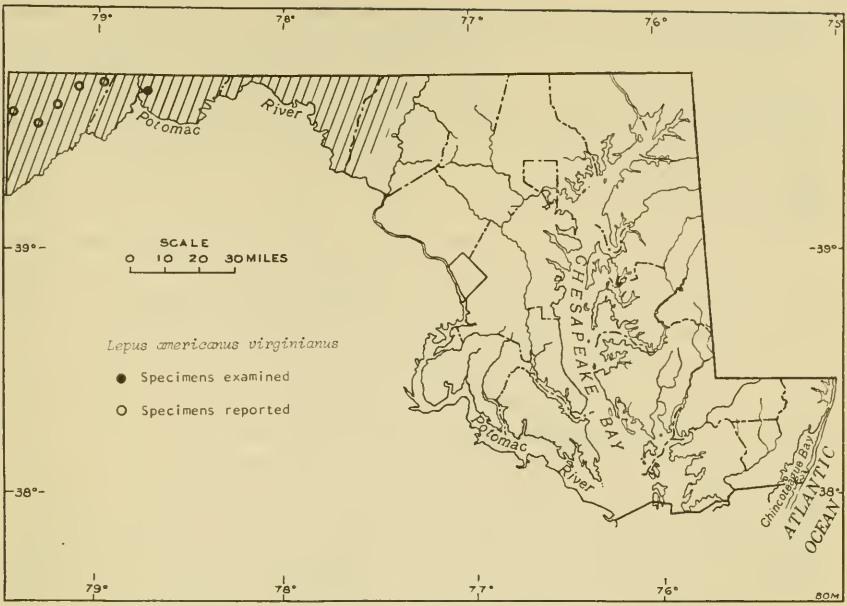

FIGURE 25.—Distribution of *Lepus americanus virginianus*.

Distribution in Maryland.—Occurs in the Allegheny Mountain and Ridge and Valley sections where it is now uncommon.

Distinguishing characteristics.—A medium-sized rabbit with large hind feet and thick fur. Coloration in summer pelage, dull rusty brown varying to buffy brown, always more or less darkened by a wash of black. In winter, coloration is sometimes pure white with a little dusky around tips of ears; but frequently a dull brownish wash is present on the feet and terminal half of the ears.

Cranially, this species differs from *Sylvilagus floridanus* and *S. transitionalis* in its larger size and heavier build, with much stronger development of the supraorbitals which are subtriangular and stand out broadly winglike with a broad open notch between the posterior process and the skull.

Measurements.—Nelson (1909, p. 86) gives average measurements of five adults from Pennsylvania as follows: Total length 518; tail vertebrae 49; hind foot 414; basilar length of skull 65.0; interorbital breadth 22.0.

Habitat and habits.—This rabbit prefers areas of spruce in the highest regions of the Allegheny Mountain and Ridge and Valley sections, where it has been observed in open woods and thickets. Spruce areas are small and scattered districts in the upland swamps and on some of the mountain tops.

Mansueti (1953, pp. 72–73) says that

The varying hare seems to be destined to permanent extirpation in Maryland. It is a species with specialized habitat requirements and one of limited distribution. Its environment is being encroached upon by civilization gradually in some and swiftly in other places. . . . The optimum habitat is forest of the high intermountain Allegheny Plateau which has at least a moderate understory of small trees and shrubs to provide food and cover. These areas are gradually being destroyed by an increasing deer herd as well as human expansion in Garrett County.

The last reliable reports of snowshoe rabbits in Maryland were by John Hamlet, formerly with the U.S. Fish and Wildlife Service, who reported that in 1945 he observed a female in Garret County but did not record the exact locality, and by John Smith of Mountain Lake who shot one near the Holy Cross Camp, Deep Creek Lake, Garrett County, in March 1957. This latter animal was probably one of 18 that had been shipped into the country from the Adirondacks of New York and released in March 1952. (Maryland Conservationist 34 (2), p. 25, March 1957.)

The snowshoe rabbit is active in the summer and winter, primarily early in the morning and late in the evening. Although it constructs no nests, it returns to the same spot regularly so that a form is eventually hollowed out. This form is nearly always concealed under grass, brush, shrubbery, or a fallen log.

This species breeds promiscuously. Mating begins early in March and may continue well into April. The first litter appears in April after a gestation period of about 36 days; as many as four litters a year are possible during a breeding season, although there are usually only two. The number of young may range from one to five or more, but most frequently three or four.

Food of the snowshoe rabbit in summer consists of dandelion, grasses, clover, ferns, and the tender parts of certain shrubs and trees. In winter, when many summer foods are not available, it feeds on bark and shoots of woody plants.

Specimens examined.—Allegany County: Cumberland, 1.

Other records and reports.—Garrett County: Cranesville Swamp area (Mansueti, 1953, p. 72); Deep Creek Lake (Maryland Conservationist 34(2), p. 25, March 1957); Finzel (Mansueti, 1953, p. 72, says that a specimen from this locality is in the collections of the U.S. National Museum and lists it among his specimens examined. There is no record, however, that a specimen from Finzel has ever been in the National Museum collections. Rhodes (1903, pp. 119–120) quotes Merriam as saying that Preble was told of the occurrence of *Lepus virginianus* at Finzel, Md., only half a mile from the Pennsylvania line. Mansueti may have confused this record with the specimen of *Lepus a. virginianus* from Cumberland, Md., which is in the National Museum collections, and which is probably the one he examined.);

Little Crossings, headwaters of North Branch of Castleman River (Browning, 1928, p. 242) ; Wolf Swamp, SE of Grantsville (Mansueti, 1953, p. 72).

Remarks.—Several hundred snowshoe rabbits have been stocked at various times in several localities in western Maryland. None of these introductions appear to have been very successful, although the specimen taken by John Smith at Deep Creek Lake in March 1957 seems to be one of those stocked in 1952.

Order RODENTIA (gnawing mammals)

Family SCIURIDAE (squirrels)

EASTERN CHIPMUNK

Tamias striatus (Linnaeus)

[*Sciurus*] *striatus* Linnaeus, Syst. nat., ed. 10, 1 : 64, 1758.

The eastern chipmunk is distributed from Quebec, New Brunswick, and Nova Scotia, south into Georgia and Louisiana, west to eastern Oklahoma, Kansas, Nebraska, North and South Dakota, and Saskatchewan. In Maryland, two subspecies are recognizable. They are—

Tamias striatus fisheri A. H. Howell

Tamias striatus fisheri A. H. Howell, J. Mammal., 6(1) : 51, 9 February 1925.

Type locality.—Merritts Corners, 4 miles E of Ossining (Sing Sing), Westchester County, N.Y.

This type locality has been the source of some confusion in the literature. It has been listed by various authorities as "Merritt's Corners, four miles W of Sing Sing [= Ossining] New York," (Howell, 1925, p. 51) ; "Merritts Corners, 4 miles E of Ossining (Sing Sing), N.Y.," (Howell, 1929, p. 16) ; "Merritts Corners, 4 miles W of Sing Sing (Ossining), Westchester County, N.Y.," (Poole and Schantz, 1942, p. 560) ; "Merritts Corners, 4 miles E of Ossining (Sing Sing), Westchester County, N.Y." (Miller and Kellogg, 1955, p. 218) : "Merritts Corners, 4 miles W Ossining (Sing Sing), Westchester County, N.Y.," (Hall and Kelson, 1959, p. 294).

The confusion involves whether Merritts Corners, a small New York State village not found on current maps of the region, actually lies west or east of Ossining, N.Y., and hence west of the Hudson River in Rockland County or east of the Hudson in Westchester County.

The locality as listed on the original label of the type specimen (U.S.N.M. Cat. No. 193370, collected on 23 August 1884, by A. K. Fisher) reads: "Sing Sing, N.Y." and on the back is written "Merritts Corners 4 miles E of Sing Sing." U.S. Geological Survey maps of the region (1893 edition, reprinted 1897) reveal that Merritts Corners, the type locality of *T. s. fisheri*, is located east of the Hudson River, in Westchester County, N.Y., at 41°11′27″ N lat., and 73°47′51″ W long., and is approximately 3¾ miles E and 1¾ miles N of Ossining, N.Y.

General distribution.—Middle Atlantic States, from the lower Hudson River Valley in New York, south to Virginia and West Virginia.

Distribution in Maryland.—Uncommon in the Eastern Shore and Western Shore sections; abundant locally in the Piedmont and Ridge and Valley sections. In the Allegheny Mountain section it is replaced by the subspecies *T. s. lysteri.* (see fig. 26.)

Distinguishing characteristics.—Teeth 1/1, 0/0, 1/1, 3/3, = 20; a small, heavyset ground squirrel with dense, moderately fine fur; pelage marked by two pale and three dark stripes on sides of face and five blackish and four pale stripes extending down the back; rump rusty in coloration; top of head and dark facial stripes near russet, light facial stripes pale buffy; dark stripes on back nearly black in color, paler stripes near smoke-gray shading posteriorly into russet; center or inner pale stripe is the broadest and always gray in coloration; tail moderately long, grayish red and not bushy. This species may be distinguished from any other in Maryland by the striping pattern of the pelage.

Measurements.—Four adults from the District of Columbia have the following external measurements: Total length 243.2 (234–255); tail 90.2 (83–99); hind foot 34.1 (33–35). Cranial measurements of nine adults from the vicinity of Washington, D.C., are as follows: Greatest length 39.5 (38.9–40.3); zygomatic breadth 22.0 (21.3–22.8); postorbital breadth 11.2 (10.6–12.2); length of nasals 13.2 (12.5–14.0).

Habitat and habits.—The chipmunk is largely a ground dweller, only rarely climbing trees. It prefers to live on wooded hillsides or mountain slopes, but is also fond of stone walls and rail fences. Though usually favoring dry situations, it is occasionally found in moist bottom land woods. It spends a good deal of time in burrows which it digs beneath a rock, stone wall, tree roots, or a building. The burrow is sometimes as much as 20 feet in length and 1 to 3 feet below the surface of the ground. The chipmunk in Maryland remains more or less active during the winter. All summer long, and especially in the autumn, it is busily engaged in storing food, primarily seeds and nuts for winter use. This food is kept in a "storeroom" adjoining the rooms where the animal is spending the winter. The food of the chipmunk consists of small seeds, berries, fruits, and nuts, and occasionally small birds, mice, snakes, snails, slug, insects, and other small animal life. Chipmunks are polyestrous and breed from March onward. The number of young is three to five, and the gestation period 31 days. Puberty is reached at the age of 2½ to 3 months.

Specimens examined.—Anne Arundel County: Epping Forest (near Annapolis), 2. *Frederick County:* Catoctin State Park, 1. *Harford County:* Fallston, 3. *Howard County:* Long Corner, 2. *Montgomery County:* Bethesda, 1; Chevy Chase, 2; Dickerson, 1; Rockville, 3; Takoma, 1; Washington Grove, 2; Linden, 1. *Prince Georges County:* Laurel, 5. *District of Columbia:* 42.

Other records and reports.—Baltimore County: Bare Hills–Lake Roland Area (Bures, 1948, p. 67); Lock Raven (Kolb, 1938); Patapsco State Park (Hampe, 1939, p. 6). *Montgomery County:* Sligo; Piney Branch; Silver Spring; Sandy Spring (all from Bailey, 1896, p. 95); Plummers Island (Goldman and Jackson, 1939, p. 133). *Prince Georges County:* Patuxent Research Center (Herman and Warbach, 1956, p. 87). *Worcester County:* near Milburn Landing (Vagn Flyger, personal communication, 22 June 1964).

Tamias striatus lysteri (Richardson)

Sciurus (*Tamias*) *lysteri* Richardson, Fauna Boreali-Americana, 1: 181, pl. 15, June 1829.

Type locality.—Penetanguishene, Ontario.

General distribution.—Nova Scotia, New Brunswick, and southeastern Ontario, south into Connecticut and Pennsylvania and in the Appalachian Mountains to western Maryland.

Distribution in Maryland.—Occurs in the higher mountains (above 2,000 feet altitude) of the Allegheny Mountain section where it is abundant.

Distinguishing characteristics.—This subspecies is similar to *T. s. fisheri*, but has paler upper parts, especially the rump and the median grayish bands. This paler coloration is most marked in the northern

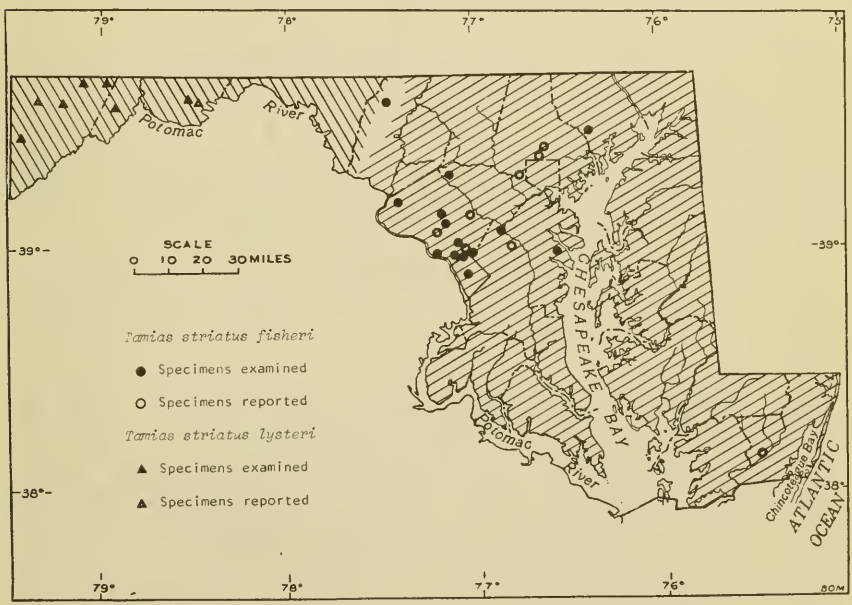

FIGURE 26.—Distribution of *Tamias striatus fisheri* and *T. s. lysteri*.

part of the range of the subspecies in the vicinity of the type locality. Maryland specimens are not so pale as typical *lysteri*.

Cranially the differences between the two subspecies are very slight. *T. s. lysteri* averages somewhat smaller, and has relatively longer nasal bones.

Measurements.—External measurements of five adults and cranial measurements of four adults from Garrett and Allegany Counties, Md., are as follows: Total length 233.4 (220–247); tail 87.8 (81–100); zygomatic breadth 21.2 (19.9–22.2); postorbital breadth 10.9 (10.5–11.2); length of nasals 13.5 (12.7–14.0).

Habitat and habits.—Similar to *T. s. fisheri*.

Specimens examined.—Allegany County: Dans Mountain (4 miles northwest of Rawlings), 1. *Garrett County:* Bittinger, 1; Cunningham Swamp, 1 (Coll. U. Md.); Finzel, 4; Grantsville, 1; Herrington Manor, 1.

Other records and reports.—Allegany County: Accident (Howell, 1929, p. 19).

Remarks.—All Maryland specimens assigned to this subspecies represent intergrades between *T. s. lysteri* and *T. s. fisheri* in coloration, size, and relative length of nasals, and assigning them to *lysteri* is somewhat arbitrary. Specimens from Fallston, Harford County, are also intergrades but are closer to *fisheri* and have been assigned herein to that subspecies.

WOODCHUCK

Marmota monax monax (Linnaeus)

[*Mus*] *monax* Linnaeus, Syst. nat., ed. 10, 1: 60, 1758.

Type locality.—Maryland.

General distribution.—Middle eastern United States from Pennsylvania, New Jersey, Ohio, Indiana, Illinois, Lower Peninsula of Michigan, and Iowa, south to Arkansas and the northern parts of Alabama, Georgia, and South Carolina.

Distribution in Maryland.—Abundant in all sections except the Eastern Shore, where it has until lately been unknown. There is recent evidence, however, that the species is extending its range into that section.

Distinguishing characteristics.—Teeth 1/1, 0/0, 2/1, 3/3, = 22; the heaviest member of the squirrel family found within the State (weight 5 to 12 lbs.); tail short and somewhat bushy; fur thick and coarse; coloration above grizzled brown, with top of head, face, legs, and tail dark brown to blackish brown; under parts lighter in coloration, and pelage not so thick; incisor teeth white; ears short and rounded.

The large size, grizzled brownish coloration, and short bushy tail readily distinguish this animal from any other rodent in Maryland.

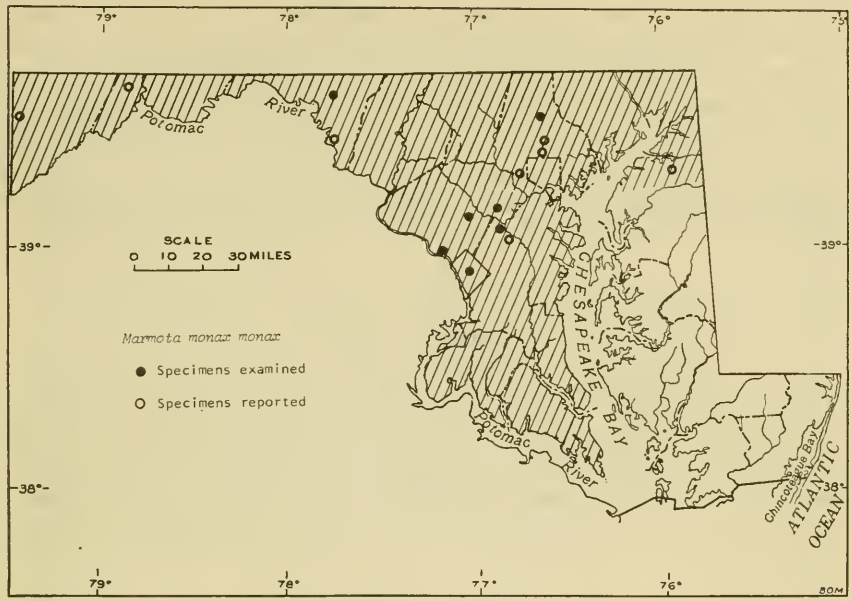

FIGURE 27.—Distribution of *Marmota monax monax*.

Measurements.—Males average larger than females in overall size. Two adult females, one from Sparks, Baltimore County, and the other from Washington, D.C., have external measurements as follows: Total length 628, 615; tail 157, 148; hind foot 88, 86. Cranial measurements of three adult males from the District of Columbia and nearby Maryland are as follows: Condylobasal length 102.6, 97.5, 95.7; palatal length 59.3, 56.2, 55.3; zygomatic breadth 69.3, 65.8, 65.9; least interorbital breadth 27.3, 25.9, 27.2; maxillary toothrow 21.7, 21.6, 22.0. Cranial measurements of five adult females average: Condylobabal length 91.3 (89.0–94.2); palatal length 53.5 (51.0–56.0); zygomatic breadth 62.5 (59.6–64.8); least interorbital breadth 24.6 (23.3–26.3); maxillary toothrow 21.1 (20.4–21.8).

Habitat and habits.—This is primarily a forest border and open field mammal, seldom found in heavy dense woods. It prefers the edges of brushy woodlands, and particularly open fields along streams. Woodchucks are found along poorly cleared fence lines, in meadows, cow pastures, and grainfields, especially where rocky outcroppings or old stumps occur. They are common on the bluffs that line the Maryland side of the Potomac River, and occur in great numbers in the farming country of Montgomery and Frederick Counties. Hampe (1939, p. 6) reports that they are very abundant throughout the Patapsco State Park, and that numerous burrows are found in the hillsides along the river. In the Bare Hills–Lake Roland region of Balti-

more County, Bures (1948, p. 67) found that they were not very common, their range being limited to areas of cultivation and the region between the deciduous woods and the marsh. Woodchucks abound in Garrett County, particularly in the vicinity of Deep Creek Lake.

This species is active both day and night and is frequently seen in grassy shoulders and rocky outcroppings that border Maryland highways. On many occasions it falls victim to modern high-speed traffic and is one of the most frequently encountered road-kills in the State.

The woodchuck inhabits an extensive burrow which sometimes extends to a depth of 5 feet and may be some 30 feet in length. The burrow usually has several entrances, which may be located beneath a wall or tree stump. Within the burrow, there is usually one chamber in which a bulky grass nest is situated. In this chamber the female gives birth to four or five young in April or May after a gestation period of about 4 weeks. The babies remain in the den for about a month, after which their eyes open, and they become completely independent of the mother by early July.

Principal food of the woodchuck consists of grasses and succulents such as clover, alfalfa, plaintain, and various perennials, in addition to beans, peas, corn, and apples; seldom does the woodchuck consume flesh, although it has been known to pursue poultry and eat insects and snails. During the summer it becomes fat on these foods, and early in the autumn when the first frost is on the ground it descends into its burrow and goes into hibernation. It usually emerges again in late February or early March.

Specimens examined.—Baltimore County: Sparks, 1. *Howard County:* Simpsonville, 1. *Montgomery County:* Plummmers Island, 4; Sandy Spring, 1. *Prince Georges County:* Laurel, 5; near Washington, D.C., 1. *Washington County:* Hagerstown, 1. *District of Columbia:* 6.

Other records and reports.—Allegany County: Mount Savage (Coll. U. Md.). *Baltimore County:* Bare Hills–Lake Roland area (Bures, 1948, p. 67) ; Lock Raven (Kolb, 1938) ; Patapsco State Park (Hampe, 1939, p. 6). *Garrett County:* Cranesville Pine Swamp (Mansueti, 1958, p. 83). *Kent County:* Galena (Allen, 1950, p. 28). *Prince Georges County:* Patuxent Research Center (Grizzell, 1949, p. 74). *Washington County:* Sharpsburg, 1 mile W (personal observation).

Remarks.—Allen (1950, p. 28) says that the Eastern Shore is one of those regions that has been invaded by the woodchuck in the last 50 years. It first appeared on the Prettyman Farm near Galena in Kent County around 1900. Evidently it is spreading southward around the Chesapeake Bay from Pennsylvania.

GRAY SQUIRREL

Sciurus carolinensis pennsylvanicus Ord

Sciurus pennsylvanica Ord, in [Guthrie], a new geographical, historical and commercial grammar; . . . , Philadelphia, ed. 2, 2: 292, 1815.

Type locality.—Pennsylvania, west of the Allegheny Ridge.

General distribution.—From southern New Brunswick, Quebec, and Ontario, south into Virginia and in the Appalachians to Tennessee, west into eastern Iowa and southern Minnesota.

Distribution in Maryland.—Abundant in all sections of the State.

Distinguishing characteristics.—Teeth 1/1, 0/0, 2/1, 3/3, = 22; size large; tail bushy and flattened; coloration variable both in summer and winter; upper parts usually yellowish brown in summer, with a slightly grayish cast to the sides of the neck, the shoulders, and thighs; face clay colored to cinnamon buff; forelegs gray above, hind legs reddish; tail brown at base, hairs blackish near middle and tipped with gray; in winter pelage, paler and more grayish.

A melanistic color phase occurs frequently in this species, particularly in *S. c. pennsylvanicus*. Albinistic animals are also often encountered.

Measurements.—External and cranial measurements of three adult males from Cambridge, Dorchester County, are as follows: Total length 462, 486, 465; tail vertebrae 201, 216, 190; hind foot 64, 64, 61;

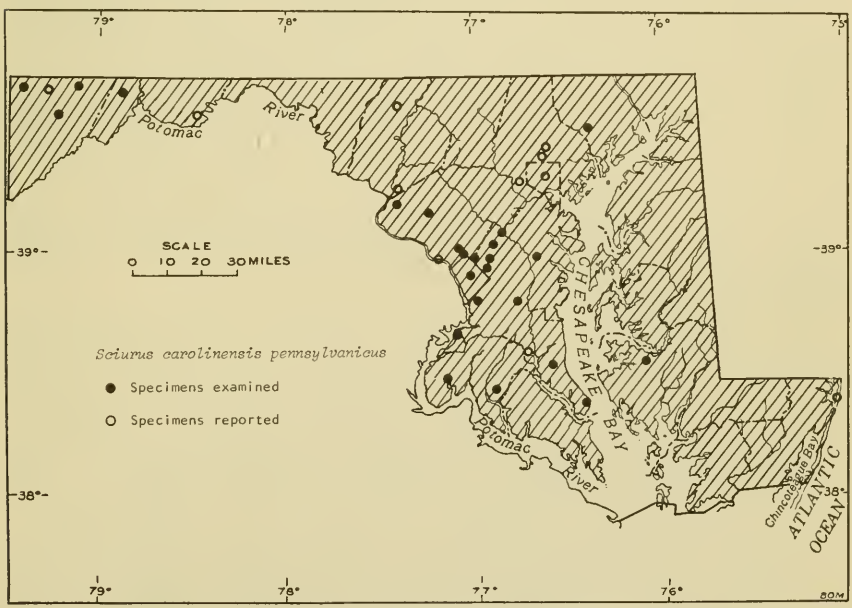

FIGURE 28.—Distribution of *Sciurus carolinensis pennsylvanicus*.

greatest length of skull 62.6, 62.4, 62.8; zygomatic breadth 33.4, 33.4, 33.6; least interorbital breadth 16.9, 19.2, 18.2; length of maxillary toothrow 10.9, 11.6, 11.2.

Habitat and habits.—This is a squirrel of the hardwood and mixed coniferous-hardwood forests, particularly those with nut-bearing trees and bushy undergrowth. It is quite common in the parks of Washington, D.C., particularly Rock Creek Park. Most of these are descended from introduced stock. Bailey (1923, p. 108) says:

> The late Dr. William L. Ralph purchased many gray squirrels and liberated them in the Smithsonian grounds, where up to the time of his death in 1907 he fed and cared for them . . . They soon became common in the Mall . . . and spread to the White House grounds, LaFayette Square, and other city parks.

Melanistics squirrels were introduced and liberated into the National Zoological Park and are still frequently seen there. Of these, Bailey (1923, p. 109) says:

> The first shipment of 10 (black squirrels) was from Rondeau Provincial Park, Morpeth, Ontario, 18 May 1906; and these squirrels were immediately liberated in the northwestern part of the zoo where they were very much at home. They have since been constanly in the park, especially from the vicinity of the great flight cage to the Klingle Valley and they have spread northward to Cleveland Park and nearly to Chevy Chase.

Five of the 31 skins of gray squirrels in the National Museum collections from the District of Columbia show melanistic tendencies.

The gray squirrel is common throughout Maryland. Hampe (1939, p. 6) says that it is the most common squirrel in the Patapsco State Park and has been observed in the Park every month of the year; young squirrels are numerous there after the first of July. Bures (1948, p. 67) says the gray squirrel is quite common in the Bare Hills-Lake Roland area. I found them numerous on the Delmarva Peninsula; in southern Maryland; in the Piedmont region, particularly in the vicinity of Sugar Loaf Mountain; and in the mountains of the western part of the State. Gray squirrels do not occur on Assateague Island, but I have seen them in the thickets back of the dunes several miles north of Ocean City.

The gray squirrel is most at home in trees and descends to the ground only when necessary to obtain food and bury nuts. It does not hibernate, even in the coldest northern portions of its range. This squirrel is diurnal and is most active in the early morning and late afternoon.

Its bulky nest is generally constructed in an enlarged natural cavity of an old oak tree, but sometimes an outdoor nest of firmly woven leaves is constructed among the branches or in the crotch of a tree.

Squirrels mate during midwinter, and the gestation period is about 40 days. A second mating usually occurs sometime in May or June. The young are two to five (generally four) in number. When 2 months

of age, they are weaned, but remain with the mother until she has her second litter.

The gray squirrel is generally vegetarian in habits, its food consisting of many kinds of nuts (including acorns), seeds, fruits, buds, fungi, inner bark of certain trees, and occasionally corn and other grains, and fleshy parts of plants. Sometimes it eats small amounts of animal food such as insects or an occasional bird's egg or small bird.

Specimens examined.—Allegany County: Mount Savage, 1 (Coll. U. Md.). *Anne Arundel County:* Priest Bridge, 1. *Calvert County:* Little Cove Point Area, 2; Prince Frederick, 1. *Charles County:* Marshall Hall, 1; Newport, 1; Port Tobacco, 2. *Dorchester County:* Cambridge, 3. *Garrett County:* Friendsville, ¼ mile NW, 1 (Coll. U. Md.); Grantsville, 2; Meadow Mountain, 1 (Coll. U. Md.). *Harford County:* Fallston, 5. *Montgomery County:* Dickerson, 1; Germantown, 2; Kensington, 1; Takoma Park, 2; Woodside, 1. *Prince Georges County:* Beltsville, 1; Bladensburg, 2; Branchville, 1; College Park, 1; Fort Washington, 1; Laurel, 22; (Upper) Marlboro, 2; Muirkirk, 1; Oxon Hill, 1; Patuxent River (fork), 2; Piscataway Creek, 2; Scagg's Swamp, 1. *District of Columbia:* 40.

Other records and reports.—Allegany County: South end of Town Hill Mountain (personal observation). *Baltimore City* (Flyger, 1960b, p. 366). *Baltimore County:* Bare Hills–Lake Roland area (Bures, 1948, p. 67); Loch Raven (Kolb, 1938); Patapsco State Park (Hampe, 1939, p. 6). *Frederick County:* Thurmont (Coll. U. Md.); Sugar Loaf Mountain (personal observation). *Garrett County:* Keyser's Ridge (Coll. U. Md.); *Montgomery County:* Plummers Island (Goldman and Jackson, 1939, p. 133). *Prince Georges County:* Aquasco (Herman, and Reilly, 1955, p. 402). *Worcester County:* Ocean City, 2 miles N (personal observation).

Remarks.—All of Maryland was formerly included within the range of the southern subspecies of gray squirrel, *Sciurus carolinensis carolinensis* Gmelin (see Bangs, 1896, p. 153, and Miller, 1924, p. 223). Patton (1939, pp. 75–76), however, in a study of the distribution of the gray squirrel in Virginia, concluded that *S. c. carolinensis* occupies the southern half of the Piedmont Plateau and the entire Coastal Plain region in that State. He says that in Virginia the area of intergradation between *S. c. carolinensis* and *S. c. leucotis* (= *pennsylvanicus*) lies along a line drawn from central King George County to southeastern Patrick County, and he assigned a specimen from Eastville, on the Virginia portion of the Delmarva Peninsula, to *S. c. carolinensis*. This suggests that, although most of Maryland lies within the range of *S. c. pennsylvanicus*, the southern portions of the Western Shore and Eastern Shore sections are within the range of *S. c. carolinensis*, and the range of the species in Maryland has been mapped in this way by

Hall and Kelson (1959, p. 371). However, a careful comparison of specimens from Calvert and Charles Counties in the Western Shore Section and Cambridge in the Eastern Shore section with specimens of typical *pennsylvanicus* from central Pennsylvania and New York show that they differ in no essential respect from that subspecies, whereas they are considerably larger and paler than typical *carolinensis*. I have also examined the specimen from Eastville, Va., assigned by Patton (1939) to *carolinensis*, and consider it to be referable to *pennsylvanicus*. It is somewhat darker than typical *pennsylvanicus*, but can be matched in coloration by many specimens in similar prelage from the northern portion of the range of *pennsylvanicus*. In size it is indistinguishable from typical *pennsylvanicus* and considerably larger than *carolinensis*. Consequently, all of Maryland falls within the range of *S. c. pennsylvanicus*, and this range extends at least as far south as Eastville on the Virginia portion of the Delmarva Peninsula and probably as far as the tip of that peninsula.

FOX SQUIRREL

Sciurus niger Linnaeus

[*Sciurus*] *niger* Linnaeus, Syst. nat. ed. 10, 1: 64, 1758.

This is our largest tree squirrel and one of the most spectacular rodents in Maryland. It resembles the gray squirrel but is considerably bigger and heavier, and less often observed. Mansueti (1952, p. 31) comments that a ratio of 40 grays to one fox squirrel may be high, but that few fox squirrels have been reported in recent years and the species appears to be becoming scarce in all the Atlantic Coast States.

The distribution of fox squirrels in Maryland has been reviewed by Mansueti (1952, pp. 31–41), and most of the following is based upon his records or records cited by him.

Two subspecies occur within Maryland. They are:

Sciurus niger cinereus Linnaeus

[*Sciurus*] *cinereus* Linnaeus, Syst. nat., ed. 10, 1: 64, 1758.

Sciurus niger bryanti H. H. Bailey, Bailey Mus. Libr. Nat. Hist., Newport News, Virginia, Bull. No. 1 [p. 1], 1 August 1920. (Type locality: Dorcester County, Md.)

Type locality.—Restricted to Cambridge, Dorchester County, Maryland, by Barkalow (1956, p. 13).

General distribution.—Formerly from Northampton County in Virginia to southeastern Pennsylvania, but now confined to the Eastern Shore section of Maryland. It has been listed by the Department of the Interior as an endangered form.

Distribution in Maryland.—Occurs in limited numbers in Dorchester, Queen Annes, Talbot, Wicomico, Somerset, and Worcester

Counties. The present center of population appears to be in the vicinity of Blackwater National Wildlife Refuge where it is still common. (See fig. 29.)

Distinguishing characteristics.—Teeth 1/1, 0/0, 1/1, 3/3, = 20; coloration uniform light grizzled-gray above with a steel blue cast; belly and feet white; tail with a pronounced black stripe on outer edges. A melanistic form occurs in which the belly and back are blackish. May be readily distinguished from the gray squirrel, which it resembles somewhat in coloration, by its much larger size and reduced dentition.

Measurements.—Five adults from Dorchester County have external measurements as follows: Total length 579 (560–605); tail 273 (263–285); hind foot 77 (73–81). Cranial measurements of four adults from Dorchester County are: Greatest length 68.5 (67.7–69.8); zygomatic breadth 38.8 (37.9–39.8); least interorbital breadth 20.8 (19.4–22.3); length of maxillary toothrow 11.9 (11.8–12.0).

Habitat and habits.—This subspecies prefers mature forests of mixed hardwoods and conifers in which mast-producing trees such as oaks, hickories, and pines are present. It is particularly partial to old-growth loblolly pine forests, many of which, however, have been cut over or burned through forest fires.

This squirrel spends much time on the ground but generally doesn't stray far from the home roost. It lies close to the body of a tree or limb, seldom leaping from tree to tree as does the gray squirrel. Nests, which serve as home during summer and winter, are placed near the tips of branches in old pines, generally from 30 to 50 feet above the ground. Mating may occur at any time throughout the year, but is most frequent during the latter part of February or early March. Usually, four young comprise a litter and are born in April.

Fox squirrels feed more on the ground than do gray squirrels. Food consists primarily of acorns, hickory nuts, walnuts, and particularly the seeds of loblolly pine. They seldom, if ever, cause damage to corn or other domestic crops.

This squirrel has become greatly reduced in numbers and has entirely disappeared from some areas of its former range. One of these areas is the northern portion of the Eastern Shore section; this is the area where this subspecies would be expected to intergrade with *Sciurus niger vulpinus*, the form inhabiting the Western Shore of Maryland.

Specimens examined.—Dorchester County: Airey (near), 1; Blackwater Refuge, 1; Bucktown, 1; Cambridge, 9. *Kent County:* East Neck Island, 3. Eastern Shore (no exact locality), 3.

Other records and reports (with dates of capture or sighting when available).—*Dorchester County:* Big Blackwater Section, 1932,

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(Dozier and Hall, 1944, p. 5); Gibbs Marsh, between Golden Hill and Church Creek, near Blackwater River (Mansueti, 1952, p. 33); Griffins Neck (Dozier and Hall, 1944, p. 10); Milton (Dozier and Hall, 1944, p. 10); Salem Woods, 14 Miles from Cambridge on road to Salisbury, 1933, (Dozier and Hall, 1944, p. 5); Secretary (Dozier and Hall, 1944, p. 10); Taylors Island, 1963, (James B. Trefethen in correspondence to Bureau of Sport Fisheries and Wildlife, 12 November 1964). *Queen Annes County:* Church Hill (near), 4 miles below Chestertown, 1943, (Dozier and Hall, 1944, p. 3). *Somerset County:* Big Swamp, 2 miles E of Kings Creek, 1922, (Dozier and Hall, 1944, p. 3); Westover, due west of, 1940, (Dozier and Hall, 1944, p. 3); Loretto, near, 1944, (Dozier and Hall, 1944, p. 3). *Talbot County:* Trappe, near, 1948, (Mansueti, 1952, p. 33). *Worcester County:* Newark, 1951, (Mansueti, 1952, p. 33); Pocomoke City, near, (Dozier and Hall, 1944, p. 3).

Sciurus niger vulpinus Gmelin

[*Sciurus*] *vulpinus* Gmelin, Syst. nat., ed. 13, p. 147, 1788 (based on specimens from the eastern United States, including the Blue Mountains of Pennsylvania).

General distribution.—Formerly occurred from central New York, south through south-central Pennsylvania, western Maryland, eastern West Virginia, western Virginia, and in the Appalachian Mountains to western North Carolina. Distribution presently reduced to south-central Pennsylvania, Maryland, western Virginia, and eastern West Virginia.

Distribution in Maryland.—Found locally in heavily forested regions in the Western Shore, Piedmont, Ridge and Valley, and Allegheny Mountain sections.

Distinguishing characteristics.—Similar in size and general characteristics to *S. n. cinereus*, but differs in coloration. The body is generally buffy brown above, in contrast to the bluish grizzled gray of *cinereus;* tail grayish white above, rufous below; feet and ears rufous; top of head more blackish than the back. May be distinguished from the gray squirrel by its larger size.

Measurements.— No external measurements are available for any of the Maryland adults in the National Museum collections. Two adults from White Sulphur Springs, West Virginia, which are typical of this subspecies have the following measurements: Total length 615, 603; tail 299, 298; hind foot 77, 79. Four Maryland specimens (two from Laurel, Prince Georges County; one from Priest Bridge, Anne Arundel County; and one from North Chesapeake Beach, Calvert County) have the following cranial measurements: Greatest length 67.7 (66.6–68.2); zygomatic breadth 38.6 (38.2–39.4); least interor-

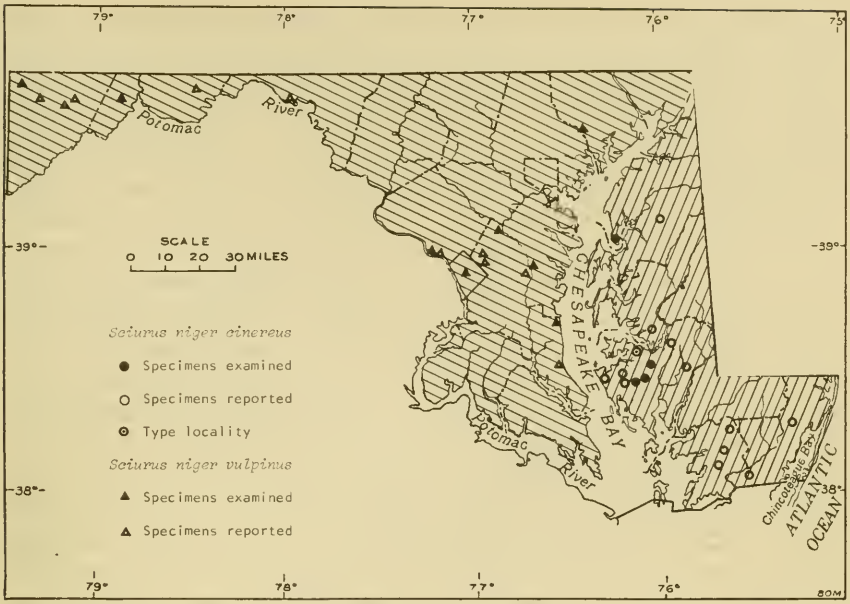

FIGURE 29.—Distribution of *Sciurus niger cinereus* and *S. n. vulpinus*.

bital breadth 20.3 (20.1–20.5); length of maxillary toothrow 11.9 (11.0–12.3).

Habitat and habits.—Not much has been published concerning the habitat and habits of this subspecies. It is said to prefer open deciduous woods, wood borders, and orchards, but as noted by Bailey (1923, p. 110) it is skillful in keeping out of sight. Mansueti (1952, p. 35) states that the subspecies has been considerably decimated in recent years, and the remaining fox squirrels are strictly local in distribution and are more or less relic populations where they occur.

Bailey (1923, p. 110) reported that at various times fox squirrels were released in the National Zoological Park in Washington, D.C. These apparently never flourished, since none have been observed in the park in years.

Specimens examined.—Allegany County: Between Clarysville and Red Hill, 1 (Coll. U. Md.). *Anne Arundel County:* Patuxent River at Priest Bridge, 10. *Calvert County:* North Chesapeake Beach, 1. *Garret County:* Friendsville, 1/4 mile NW, 2 (Coll. U. Md.). *Harford County:* Fallston, 1. *Prince Georges County:* Laurel, 4. *District of Columbia:* 4 (these were either purchased at the Central Market or trapped in the National Zoological Park, and probably are not actually from the District of Columbia area).

Other records and reports (from Mansueti, 1952, except where otherwise noted.—*Allegany County:* Green Ridge State Forest, 1935.

Calvert County: Governors Run, 1948 (?). *Garrett County:* Accident 1945 and 1951; Bittinger, 1948; Meadow Mountain, 1947. *Montgomery County:* Great Falls, 1916; Plummers Island (Goldman and Jackson, 1939, p. 133). *Prince Georges County:* Bladensburg (near), 1949 (?). College Park, 1948; 1/2 mile east of intersection of Highways 214 and 301, 1940. *Washington County:* Fort Frederick State Park, 1950.

Remarks.—Mansueti (1952, p. 35) lists on a provisional basis a third subspecies of the fox squirrel in Maryland, the more western *Sciurus n. rufiventer.* He and Vagn Flyger in 1950 examined the tail of a fox squirrel shot on a hill near Storey's Landing, Deep Creek Lake, Garrett County, several years before, and found that its coloration was similar to that of *rufiventer.* This subspecies normally occurs west of the Allegheny Mountains and prefers open or parklike upland woods rather than heavily forested sections. It commonly occurs along fence rows in cultivated fields or in pastures where there are only scattered trees. Mansueti claims that these conditions are found in many parts of Garrett County, particularly around Deep Creek Lake and that *rufiventer* may be moving into this area from further west. He states that possibly as the heavily forested areas are cut, and *S. n. vulpinus* vacates, *S. n. rufiventer* invades the area vacated. On the other hand, he notes that numbers of *S. n. rufiventer* have been released in southwestern Pennsylvania in an effort to restock the area and some of these may have migrated south into Maryland. The two specimens from Garrett County that I have examined, however, are typical *S. n. vulpinus* and exhibit none of the characters of *rufiventer.*

RED SQUIRREL

Tamiasciurus hudsonicus loquax (Bangs)

Sciurus hudsonicus loquax Bangs, Proc. Biol. Soc. Washington, 10: 161, 28 December 1896.

Type locality.—Liberty Hill, Conn.

General distribution.—Southern Ontario, southern Vermont and New Hampshire, south to northern Virginia and West Virginia, west to eastern Iowa and southeastern Minnesota.

Distribution in Maryland.—Occurs locally in the Piedmont, Ridge and Valley, and Allegheny Mountain sections; scarce or absent over most of the Western Shore section; apparently absent in the Eastern Shore section.

Distinguishing characteristics.—Teeth 1/1, 0/0, 2/1, 3/3, = 22; anterior upper premolar frequently lacking, and when present so reduced as to be easily overlooked; size small, the smallest of our local tree squirrels; tail relatively short and bushy; general coloration in winter bright rufous above, white below; ears tufted with black; in summer, coloration more olive dorsally, with ears untufted.

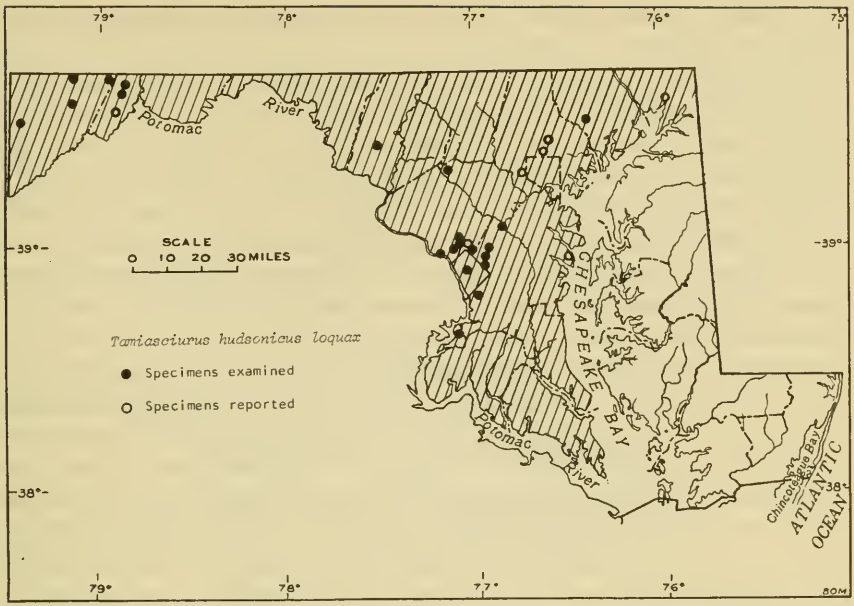

FIGURE 30.—Distribution of *Tamiasciurus hudsonicus loquax.*

This squirrel is differentiated from all others in Maryland by its small size and reddish coloration.

Measurements.—Two adults from the vicinity of Bethesda, Montgomery County, have external measurements as follows: Total length 310, 303; tail 130, 130; hind foot 50, 51; ear 22, 27. Cranial measurements of 10 adults from Laurel, Prince Georges County are: Greatest length 45.2 (44.4–46.0); zygomatic breadth 26.2 (26.0–27.2); least interorbital breadth 13.9 (13.1–14.6); length of maxillary toothrow 7.2 (6.6–7.8).

Habitat and habits.—This squirrel prefers spruce and hemlock forests, but is often found in deciduous woods and in rural areas in the northern hardwoods region where it sometimes builds nests in the attics of houses. It is more terrestrial than the gray squirrel, spending a great deal of time on the ground searching for food. It is also more omnivorous than the gray squirrel, eating almost any kind of seed, nut, or berry. Various kinds of fungi are consumed and even an occasional egg when the nest of a songbird is raided. Hamilton (1943, p. 224) says that it has been known to kill and partially devour young cottontail rabbits.

The bulky nest of the red squirrel, made of grass and moss, is usually placed high in the branches of a tree and can be distinguished from that of the gray squirrel by its smaller size and the finer material used in its construction. The red squirrel is active throughout the year.

It produces litters of from three to six young early in the spring and often a second litter in late summer.

The center of Maryland's red squirrel population is the spruce and hemlock forests of the Allegheny Mountain section of the State. It is scarce or absent over most of the Western Shore section and apparently lacking in the Eastern Shore section. David H. Johnson, formerly Curator of Mammals, U.S. National Museum, tells me that he is very familiar with pine woods near Greenbelt, Prince Georges County, and never observed a red squirrel there. J. C. Lingebach, Division of Mammals, U.S. National Museum, advises me that in his many years of field experience in the Annapolis area of Anne Arundel County he never observed a red squirrel. Flyger (1957, p. 1), however, reports that he trapped a red squirrel on 23 February 1957 near the Naval Academy in Annapolis and that there had been a colony there for several years. This is probably an artificially introduced population. Red squirrels have, however, been taken at such Western Shore section localities as Laurel, Bladensburg, Oxon Hill, Riverdale, and College Park, in Prince Georges County, and Marshall Hall in Charles County. These localities are not very distant from the fall line and the beginning of the Piedmont section, and elsewhere in the Western Shore section the red squirrel appears to be exceedingly scarce.

Even in the Piedmont section the species is only locally abundant, being completely absent over large areas. At one time it was numerous in Rock Creek Park in Washington, D.C., but none have been seen there in recent years. It is still plentiful in some suburban areas northwest of Washington. A lactating female was found dead by David H. Johnson on a road adjacent to a pine woods a few miles northwest of Bethesda, Montgomery County, in October 1955, and another near this general area in September 1957. Johnson tells me that it is the common squirrel in some of the pine woods in the Bethesda area, being more often seen there than gray squirrels. In the Piedmont section of Baltimore County, Hampe (1939, p. 6) reported red squirrels uncommon in the pine woods of the Patapsco State Park, but Bures (1948, p. 67) found that it was a common resident of the Bare Hills–Lake Roland area a few miles to the northeast. Evidently, the red squirrel has a scattered distribution in Maryland and is only abundant locally.

Specimens examined.—Allegany County: Frostburg, 1; Mount Savage, 2 (Coll. U. Md.). *Charles County:* Marshall Hall, 1. *Frederick County:* Middletown, 6. *Garrett County:* Bittinger, 1; Finzel, 2; Grantsville, 1; Swallow Falls State Park, 1. *Harford County:* Fallston, 1. *Howard County:* Long Corner, 1. *Montgomery County:* Bethesda, 3½ miles NW, 1; Bethesda, 5 miles NW, 1; Kensington, 8; Linden, 2; Plummers Island, 1; Takoma Park, 3. *Prince Georges*

County: Bladensburg, 2; College Park (near), 1; Laurel, 16; Oxon Hill, 1; Riverdale, 1. *District of Columbia:* 25.

Other records and reports.—Allegany County: Dans Mountain (Coll. U. Md.). *Anne Arundel County:* Annapolis (Flyger, 1957, p. 1). *Baltimore County:* Bare Hills–Lake Roland area (Bures, 1948, p. 67); Loch Raven (Kolb, 1938); Patapsco State Park (Hampe, 1939, p. 6). *Cecil County:* Northeast (Coll. Acad. Nat. Sci. Philadelphia). *Montgomery County:* Silver Spring (files of U.S. Fish and Wildlife Service). *Prince Georges County:* Hyattsville (Bailey, 1923, p. 107).

Remarks.—Specimens from Garrett County and Allegany County appear somewhat darker in summer and winter pelage than specimens from farther east in the State and may represent intergrades with the southern Appalachian subspecies *T. h. abieticola.*

SOUTHERN FLYING SQUIRREL

Glaucomys volans volans (Linnaeus)

[*Mus*] *volans* Linnaeus, Syst. Nat., ed. 10, 1: 63, 1758.

Type locality.—Virginia (fixed by Elliot, Field Columb. Mus., Zool. Ser., 2: 109, 1901).

General distribution.—From central Minnesota, Upper and Lower Peninsulas of Michigan, southeastern Ontario, New York, and southern New Hampshire, south to North Carolina and Tennessee, west to eastern Kansas and Nebraska.

Distribution in Maryland.—Probably abundant in all sections of the State where there is suitable habitat. No specimens or records are available, however, from the Eastern Shore, Ridge and Valley, and Allegheny Mountain sections, but this probably indicates that these sections have not been systematically trapped for the species rather than a scarcity of the animals themselves. Flying squirrels are nocturnal, shy, and seldom observed.

Distinguishing characteristics.—Teeth 1/1, 0/0, 2/1, 3/3, = 22; a small squirrel that is characterized by a "flying membrane", a loose fold of fully furred skin connecting the fore and hind limbs from wrists to ankles. The tail is broad, flattened, and almost parallel-sided, with the tip rounded; pelage extremely soft and dense; coloration of upper parts varies with season and age, but is generally grayish brown; under parts ususally white or creamy white in coloration, with the white extending from the base of the hairs to the tip; dark brown streak extending along side edge of "flying membrane"; tail grayish above, cinnamon below; forefeet white, hind feet brown except for some white on toes.

This species may be distinguished from all other squirrels in Maryland by the distinctive "flying membrane." The northern flying squirrel, *Glaucomys sabrinus*, has not as yet been reported from Maryland,

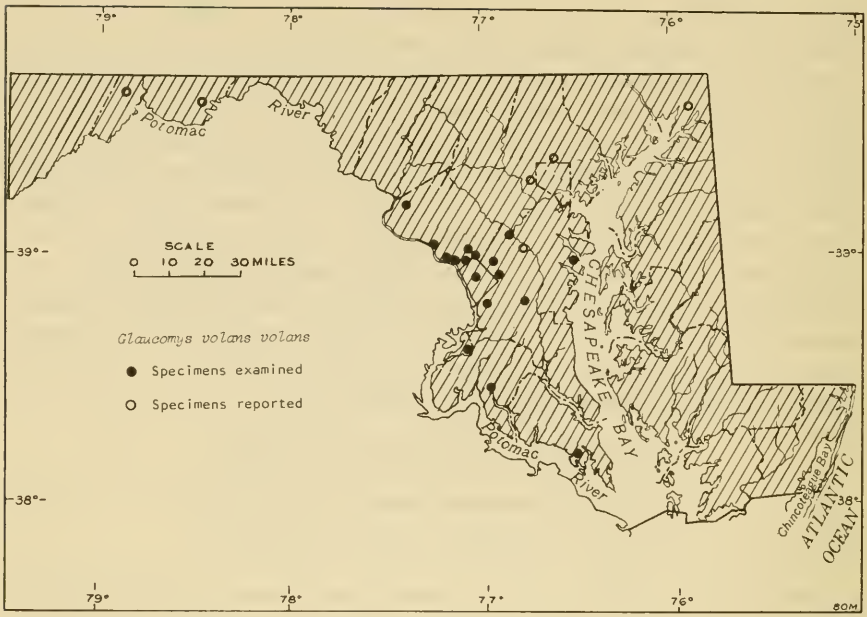

FIGURE 31.—Distribution of *Glaucomys volans volans.*

but may occur in spruce and fir forests in the highest elevations of the Allegheny Mountain section. It differs from the present species primarily in that it is much larger in size and the basal portion of the white hairs of the belly are colored grayish.

Measurements.—External and cranial measurements of eight adults from Newport, Charles County, are as follows: Total length 221.9 (211–240); tail vertebrae 97.9 (90–110); hind foot 26.6 (21–30); greatest length of skull 34.6 (33.5–35.6); zygomatic breadth 20.5 (19.7–21.3); interorbital breadth 6.9 (6.5–7.5); length of maxillary tooth row 6.4 (6.2–6.5).

Habitat and habits.—This is essentially a species of the heavy timber and is never found at any great distance from water. It prefers forests of deciduous trees, but is sometimes encountered in woodlands of mixed conifers and hardwoods. Occasionally it may occupy an old orchard.

The species is probably abundant in all sections of the State where there is suitable habitat, but because of its secretive habits it is seldom noticed. Bures (1948, p. 67) says that in the Bare Hills–Lake Roland area of Baltimore County it is as common as the chipmunk, but because of its nocturnal habits is less often observed. Hampe (1939, p. 6) found that it was fairly common in the Patapsco State Park. He observed one at twilight on 22 May 1936. Bailey (1923, p. 112) found the species common in the woods of the District of Columbia, right up to the edge of the city.

The flying squirrel is one of the most nocturnal mammals in Maryland, rarely leaving its nest before the sun is well down. It remains active throughout the night, foraging for hickory nuts, beechnuts, acorns, maple and wild cherry seeds, apples, and buds and blossoms of some trees. It is carnivorous to some extent and occasionally feeds on insects, young birds, and birds' eggs. This squirrel is highly social.

The favorite nesting site for the flying squirrel is a hole in a dead or dying tree. A cavity made by a woodpecker is often preferred, although occasionally a natural one will be utilized and artificial bird nest boxes are sometimes used. The nest is composed of finely shredded leaves and inner bark.

This species probably does not hibernate in Maryland, although farther north it becomes inactive during colder weather (Sollberger, 1940, p. 285). Mating may occur in late February or early March and the gestation period is about 40 days. Three young usually comprise a litter, and a second mating sometimes occurs in July (Sollberger, 1943, p. 163).

Specimens examined.—Anne Arundel County: Annapolis, 3 miles NW, 1. *Charles County:* Marshall Hall, 2; Newport, 10. *Montgomery County:* Cabin John Creek, 1; Capitol View, 1; Chevy Chase, 1; Dickerson, 1; Garrett Park, 1; Glen Echo Heights, 1; Great Falls, 1; Kensington, 2; Plummers Island (near), 1; Silver Spring, 4. *Prince Georges County:* Anacostia River, NW Branch, 1; Branchville, 1; Laurel, 2; Upper Marlboro, 1; no exact locality, 3. *St. Marys County:* Tall Timbers, 1.

Other records and reports.—Allegany County: Mount Savage (Coll. U. Md.); Town Hill (Coll. U. Md.). *Baltimore County:* Bare Hills–Lake Roland area (Bures, 1948, p. 67); Patapsco State Park (Hampe, 1939, p. 6). *Cecil County:* Bacon Hill (3 specimens in Phila. Acad. Nat. Sci.). *Montgomery County:* Forest Glen (Bangs, 1896, p. 166). *Prince Georges County:* Patuxent Research Center (Herman and Warbach, 1956, p. 87).

Family CASTORIDAE (beavers)

BEAVER

Castor canadensis Kuhl

Castor canadensis Kuhl, Beitr. z. zool. u. vergleich. Anat., Abth. 1, p. 64, 1820.

Type locality.—Hudson Bay.

General distribution.—Formerly ranged over most of the forested regions of North America, north of Mexico. It was exterminated in many areas of its range and later successfully reintroduced into some sections.

Distribution in Maryland.—Formerly occurred in all sections of the State, but was exterminated around the turn of the century or earlier. It has been deliberately restocked in some areas and naturally invaded others from neighboring States where animals were stocked or remnant populations survived.

Distinguishing characteristics.—Teeth 1/1, 0/0, 1/1, 3/3, = 20; largest rodent in Maryland; body thickset and compact; legs short; ears small; hind feet large with the toes webbed; tail broad, flat, nearly hairless, and covered with large scales; pelage with very soft dense underfur, overlaid with long coarse guard hairs; coloration dark rich brown above, lighter below.

Measurements.—"Nine adults from the Allegheny National Forest, Pennsylvania, average: Total length, 1,031 mm. (970–1,090 mm.); tail vertebrae, 358 mm. (260–440 mm.); greatest width of tail, 129 mm. (112–150 mm.); hind foot, 169 mm. (156–183.)." (Handley and Patton, 1947, p. 158).

"The skull is large and massive, that of the adult more than 120 mm. long and 85 mm. broad; . . . length of upper molar series about 28 to 30 mm." (Jackson, 1961, p. 192).

Habitat and habits.—This species prefers forested areas wherever there are suitable watercourses for the construction of dams and lodges. The sluggish fresh-water streams of the Eastern Shore section are especially suited to their needs.

The beaver feeds on a wide range of plants. These may be sedges, rushes, water grasses, various roots and tubers, and bark, leaves, and twigs of bushes and trees. In winter it feeds primarily on green branches that it stores under water near the lodge. In Maryland its favorite trees appear to be sweetgum, pine, ash, dogwood, oak, and maple.

These animals are monogamous, and it is believed that they mate for life. Breeding begins about mid-January and extends to the end of February. The gestation period is approximately 120 days, and a single litter of from one to eight kits is produced a year (the most frequent number being four or five).

The beaver's most important activity is felling trees for dams and lodges. A large beaver lodge is about 5 to 6 feet high and 15 or 20 feet wide at the water level. More often, however, smaller lodges are built, some 3 to 4 feet in height and 8 to 10 feet in diameter. The inside of a lodge consists of one room about 2 to 3 feet in height, and as many as 8 to 10 beaver may occupy it. The opening to the lodge is always under water. Many beavers, however, that inhabit lakes or deep streams live in bank dens rather than constructing lodges and dams.

The beaver is active throughout the year, but is seldom active during daylight hours. Its routine workday begins at dusk and ends at dawn.

Young beavers in their second year leave the parental colonies and emigrate to establish themselves in new colonies by pairs. Sometimes they may move as much as 30 miles to a new home. Most of this movement is accomplished in the water, because the animal is quite clumsy and slow moving on land.

According to Mansueti (1950, p. 33) no one knows when Maryland's native beavers were finally exterminated. He judges that on the basis of when they disappeared in Pennsylvania and New Jersey, they probably were gone from the Maryland lowlands about 150 years ago and that there were probably some native beavers left in western Maryland less than 100 years ago. Their extirpation was due to a number of reasons, the primary ones being heavy trapping pressure for their pelts, and elimination of suitable habitat. Beaver have reappeared in Maryland in recent years either through deliberate introductions or as a result of their natural migrations from other states where they had not been entirely extirpated or had been stocked. They are flourishing now in certain areas, presumably because low pelt value makes trapping unprofitable in the State.

Recent records and reports.—Bonwill and Owens (1939, pp. 36–37) mention 3 areas of Maryland where these animals were thriving in 1939. One was on the Upper Potomac River near Gormania, Garrett County; the second on Town Creek in Allegany County; and the third at a point where the Andover and Sewell Creeks meet at the head of the Chester River in Kent County. They believe that the first two colonies were the result of migrations from colonies in Pennsylvania or West Virginia that had escaped extermination in those States or had been reintroduced there. The Kent County colony was a result of migration from a colony in Delaware which had been stocked with animals from Maine by the Delaware Board of Game and Fish Commissioners in 1935.

Arner (1949, p. 23) says that the beaver migrated into the western Maryland Counties of Garrett and Allegany from colonies in West Virginia and are firmly established in eight streams in Garrett County and three streams in Allegany. They may be found in Garrett County in the Youghiogheny River, Laurel Run, Harrington Creek, and Broad Ford Run. In Allegany County they inhabit Evitts Creek and Town Creek; and beaver cuttings have been found on Sideling Hill in Washington County. He estimates that in 1949 there were 150 beavers in western Maryland.

Remarks.—Authorities are in agreement that Maryland's native beaver population probably represented the subspecies *C. c. canadensis*. It is impossible to assign subspecific rank to Maryland's present beaver population since they come from so many different sources, and even some of the areas from which they have been stocked were

themselves stocked at an earlier period with animals from elsewhere. No specimens of the native population or the present population of beavers have been available to me for examination.

Family CRICETIDAE (deer mice, harvest mice, voles, etc.)

MARSH RICE RAT

Oryzomys palustris palustris (Harlan)

Mus palustris Harlan, Silliman's Amer. Jour. Sci., 31 : 385, 1837.

Type locality.—"Fast Land" near Salem, Salem County, N.J.

General distribution.—In the Coastal Plain from southeastern Pennsylvania and southern New Jersey, south to northern Florida, west to the Mississippi River and north in the Mississippi Valley to southeastern Missouri, southern Illinois, and central Kentucky.

Distribution in Maryland.—Recorded only from the Eastern Shore and Western Shore sections.

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; ratlike in general appearance, but considerably smaller than adult Norway rat; tail long, nearly half the total length; fur long and coarse; color of upper parts grizzled grayish brown, mixed with blackish, sides paler with less blackish; underparts white to pale buff; tail sparsely haired and scaly, brownish above and whitish below. Young animals are more grayish than adults.

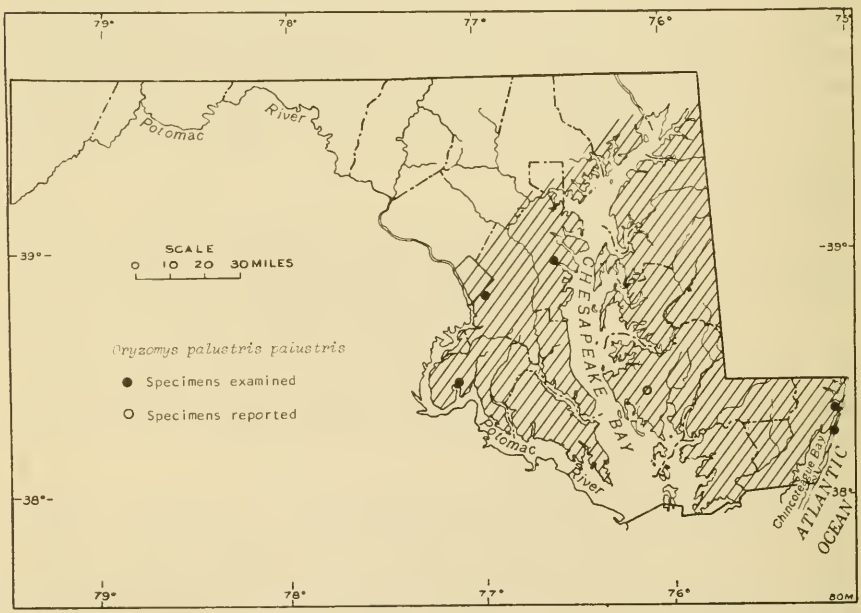

FIGURE 32.—Distribution of *Oryzomys palustris palustris.*

Marsh rice rats superficially resemble young Norway rats from which they may be distinguished by the upper cheek teeth. These teeth have two longitudinal rows of tubercles in rice rats; in Norway rats there are three such rows.

Measurements.—An average-sized female from West Ocean City, Worcester County, has measurements as follows: Total length 247; tail 120; hind foot 30; ear 10; greatest length of skull 30.4; zygomatic breadth 16.4; interorbital breadth 4.9; length of upper molar toothrow 4.4.

An adult female from Nanjemoy Creek, Charles County, has the following external measurements: Total length 262; tail 127; hind foot 30.

There is a peculiar size variation often encountered in this species. Males and females generally average about the same size, but often an apparently adult female may be strikingly smaller than the average.

Habitat and habits.—This species is partially amphibious and shows a great preference for wet meadows, marshy areas, watercourses, cane breaks, and swamps, and is only rarely encountered in dry fields.

Marsh rice rats are polyestrous and breed from March to November in Maryland (Harris, 1953, p. 485). The gestation period is 25 days and the female mates again immediately after parturition. Litter size varies from one to five with the average being three.

This species is an accomplished swimmer and does not hesitate to dive and swim under water for great distances when alarmed. It makes nests of grasses and weeds which may be placed under a mass of tangled debris or woven into the rushes a foot or more above the high water level. Its presence may usually be detected by the extensive and well-defined runways it makes and by the mats of cut vegetation floating at irregular intervals in the tidal waters. Sometimes, however, there may be little evidence of rice rats in an area. Harris (1953, p. 481) says that in the Blackwater National Wildlife Refuge in Dorchester County 40 percent of the 86 rice rat captures were made at trap stations showing no signs of small mammals, but some were taken at muskrat houses. Also, he was never able to locate any rice rat nests in this area, and noted that only a few of the runways found might have been made by this species. Rice rats are primarily nocturnal, and Harris states that only rarely was this species observed in the daytime.

In Maryland, rice rats are confined in distribution to the fresh and salt water marshes of the Western Shore and Eastern Shore sections. They seem to be particularly numerous in the fresh, brackish, and salt water marshes of the lower Eastern Shore section and occur in great numbers on Assateague Island, where they occupy the wetter portions of these marshes.

Specimens examined.—Anne Arundel County: South River, at U.S. Route 50, 1. *Charles County:* Nanjemoy Creek, 5. *Prince Georges County:* Oxon Hill, 2 miles NW, 2. *Worcester County:* Ocean City, 4 and 5 miles S (Assateague Island), 2; West Ocean City, 4.

Other records and reports.—Dorchester County: Blackwater National Wildlife Refuge (Harris, 1953).

EASTERN HARVEST MOUSE

Reithrodontomys humulis virginianus A. H. Howell

Reithrodontomys humulis virginianus A. H. Howell, Jour. Mammal., 21 (3) : 346, 13 August 1940.

Type locality.—Amelia, Va.

General distribution.—Known from central Virginia north to Maryland. Exact northern limits of range unknown.

Distribution in Maryland.—Rare in Maryland; probably occurs only in the Western Shore and southern Piedmont sections.

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; upper incisors with conspicuous grooves; mouselike in form; tail about half total length; coloration grayish-brown above with a distinct band of blackish along the median line; sides of head and body paler, more or less washed with light pinkish cinnamon, this color forming a definite lateral line next to the belly; underparts grayish white; tail bicolored, fuscous above, grayish white below; ears fuscous, feet white.

This species closely resembles the house mouse (*Mus musculus*) in general appearance, but may readily be distinguished from that species by the deeply grooved upper incisors. In the eastern United States the harvest mouse is the only long-tailed cricetine rodent with grooved incisors.

Measurements.—An adult female from Takoma Park (near Riggs Mill), Prince Georges County, measures as follows: Total length 132; tail 59; hind foot 15.5; ear 12; greatest length of skull 20.0; zygomatic breadth 10.1; least interorbital breadth 2.9; upper molar toothrow 2.5.

Howell (1940, p. 346) gives external measurements of 10 specimens from the type locality as follows: Total length 117.2 (110–125); tail vertebrae 51.8 (45–56); hind foot 16.2. The greatest length of skull of these 10 specimens is 18.7 (18.3–19.1). It can be seen that the Maryland specimen is considerably larger both externally and in the greatest length of the skull than topotypes of the subspecies from Amelia, Va.

Habitat and habits.—The harvest mouse prefers nonforested land, particularly cultivated fields where grain crops are growing. It seems to be equally at home in dry fields or in bogs, provided there is thick growth of tall grasses or sedges.

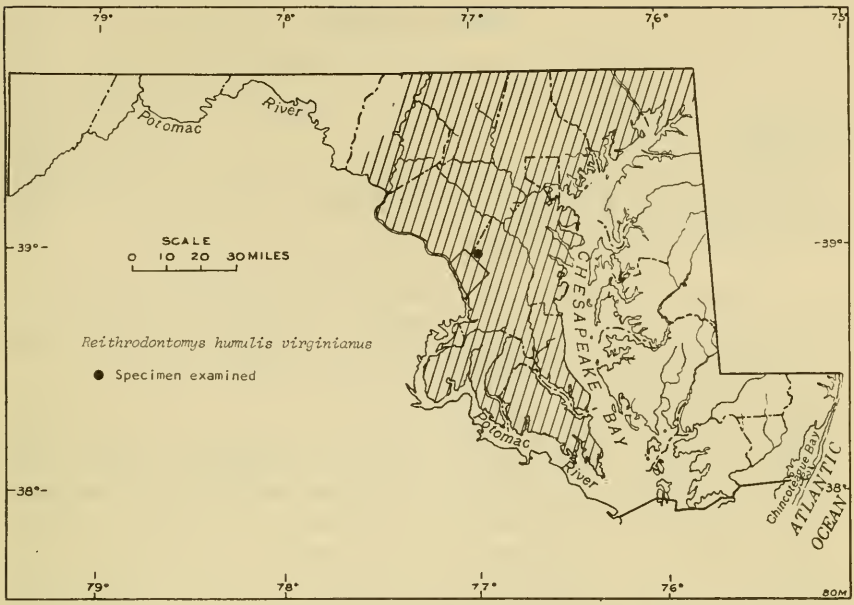

FIGURE 33.—Distribution of *Reithrodontomys humulis virginianus.*

Little is known of the habits of this species. It lives in the cover of grass, weeds, and grains where it makes little runways over the surface of the ground. According to Lewis (1940, p. 426), in Amelia County, Va., it generally makes nests of fine grass blades on top of the ground in tall grass or sedges. These nests are globular and average larger than a croquet ball.

The breeding season is from May to November; the number of young from one to five; the gestation period is about 23 days.

The food of the eastern harvest mouse consists largely of seeds and grains with considerable green vegetation and occasionally fruit (Howell, 1914, p. 11).

According to Bailey (1923, p. 118), many skulls of harvest mice were found in owl pellets in the Smithsonian tower in Washington, D.C. The owl, or owls, however, may have been feeding in nearby Virginia and thus the skulls may not represent District of Columbia or Maryland records. This rodent species has been trapped at only one locality in Maryland.

Specimens examined.—Prince Georges County: Takoma Park (near Riggs Mill), 1. Howell (1940, p. 346), reported examining two specimens from Riggs Mill, and records in the files of the U.S. Fish and Wildlife Service indicate that Ray Greenfield actually took three specimens in that same area on 26 January 1934. Only one specimen from that locality, however, is now in the National collections.

DEER MOUSE

Peromyscus maniculatus (Wagner)

Hesperomys maniculatus Wagner, Arch. Naturgesch., Jahrg. 11, 1: 148, 1845.

This is a wide-ranging species that occurs over much of North America. Numerous subspecies have been described; of these, two are known to occur in Maryland. They are:

Peromyscus maniculatus bairdii (Hoy and Kennicott)

Mus bairdii Hoy and Kennicott, in Kennicott, Agricultural Report, U.S. Commissioners Patents, 1856, p. 92, 1897.

Type locality.—Bloomington, McLean County, Ill.

General distribution.—Prairie region of the upper Mississippi Valley, from eastern Kansas and Missouri; north to southwestern Manitoba, Canada; eastward through southern Minnesota, Wisconsin, and Michigan to the man-made prairie of central New York, Pennsylvania, Maryland, and northern Virginia.

Distribution in Maryland.—The distribution of this subspecies within the State is unknown. It has been taken in Maryland only at the Patuxent Research Center, Prince Georges County. (See fig. 34.)

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; coloration of upperparts brownish gray, mixed with darker hairs; underparts white, the basal gray of the underfur often conspicuous; tail short and distinctly bicolored, upperparts brownish black, white beneath; feet white. Immature animals are more grayish dorsally.

This subspecies is readily distinguished from *Peromyscus maniculatus nubiterrae* by its much shorter tail. It is easily confused with *Peromyscus leucopus*, but may be distinguished by several characters which are discussed under that species.

Measurements.—External measurements of two adults from the Patuxent Research Center, Prince Georges County, (a wild-caught female and one of her laboratory-raised offspring) are as follows: Total length 152, 149; tail 63, 59; hind foot 18, 19; ear 13.5, 14.0. Cranial measurements of three adults from the Patuxent Research Center (the wild-caught female and two of her laboratory-raised offspring) are: Greatest length 23.1, 23.3, 23.0; zygomatic breadth 11.5, 12.1, 11.9; interorbital breadth 3.7, 3.9, 3.9; length of maxillary toothrow 3.0, 3.3, 3.3.

Habitat and habits.—This subspecies inhabits prairies, open fields, and arable land and is entirely absent from dense forests. It was unknown in Maryland until 1949, when Lucille F. Stickel and Oscar Warbach live-trapped several in crop fields at the Patuxent Research Center. These fields are about 1.9 miles north of Bowie and are situated on a wide bench of sandy clay near the Patuxent River. From May

1949 to June 1950, 23 of these mice were captured by Stickel and Warbach.

According to W. H. Stickel (1951, p. 26) the Maryland specimens of this race were most often caught in corn and in young wheat; only occasionally were they found in hay or tall wheat. He says that the subspecies seems to be precariously established at the Patuxent Research Center and was not common, nor did the numbers appear to increase, during the year the area was extensively studied.

Peromyscus m. bairdii is essentially a subspecies of the prairie region of the upper Mississippi Valley. In recent years it appears to have been extending its range eastward consequent with the deforestation of wide areas of land in the eastern United States. In 1909, Osgood (1909, p. 79) knew it only from as far east as Ohio. In 1934, Mitchell (1934, p. 71) recorded it from Meadville, Pa., and in 1938, Moulthrop (1938, p. 503) listed it from Elba, Genesee County, N.Y. Hamilton (1950, p. 100) recorded the first appearance of *bairdii* in 1947 at Ithaca, N.Y., an area that had been heavily trapped for the previous 20 years, and mentioned the capture of the subspecies at North Harrisburg, Dauphin County, Pa., the first record from east of the Appalachian Mountains. More recently, Peacock and Peacock (1962, p. 98) have taken specimens from the area being developed into Dulles Airport, near Chantilly, Fairfax County, Va.

Stickel (1951, p. 26) states that no doubt the animal is expanding its range by natural means in consequence of artificially created habitats, but the possibility of accidental transportation is considerable. It may be that the mouse has succeeded in crossing the heavily forested Appalachian Mountains by following the grass-lined banks and shoulders that line the roads in that area. It would in this way remain ecologically separated from *Peromyscus m. nubiterrae*, the race inhabiting the dense forests of the Appalachians.

Just how widely *bairdii* is distributed in Maryland is unknown. No additional specimens have been taken since Stickel and Warbach collected those at the Patuxent Research Center in 1939. I have trapped many cultivated fields in central Maryland and grassy roadsides in the western part of the State with the hope of obtaining additional records, but without success. The recent records from nearby Chantilly, Va., however, lead me to believe that the subspecies is probably widely distributed, although perhaps scarce as regards total numbers, in open fields throughout Maryland.

These mice feed largely on seeds, grain, and the ripe heads of grasses; berries and numerous insects are also consumed. The nest is built slightly underground, or on the surface, and usually placed under some object, such as a board, fallen tree limb, rock, or old pasteboard carton. The breeding season generally begins in early March and ex-

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tends through November. A female may breed three or four times yearly, and a litter may contain from two to nine young, although four to six is the most common number.

Specimens examined.—Prince Georges County: Patuxent Research Center, 3.

Peromyscus maniculatus nubiterrae Rhoads

Peromyscus leucopus nubiterrae Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 48: 187, April 1896.

Type locality.—Summit of Roan Mountain, Mitchell County, North Carolina. Altitude 6,370 feet.

General distribution.—Allegheny and Blue Ridge Mountains and adjacent ranges from western Pennsylvania and New York, south to western North Carolina and northeastern Georgia.

Distribution in Maryland.—Found in the Allegheny Mountain section at elevations usually above 2,500 feet.

Distinguishing characteristics.—Similar in coloration and size to *P. m. bairdii*, but is readily distinguished from that subspecies by its much longer tail, which is more than half the total length of the animal. Usually *nubiterrae* has larger ears and feet than *bairdii*.

In general, *nubiterrae* can be distinguished from *Peromyscus leucopus* by certain subtle differences in coloration. Some specimens of *nubiterrae*, however, are confusingly similar to *Peromyscus leucopus*,

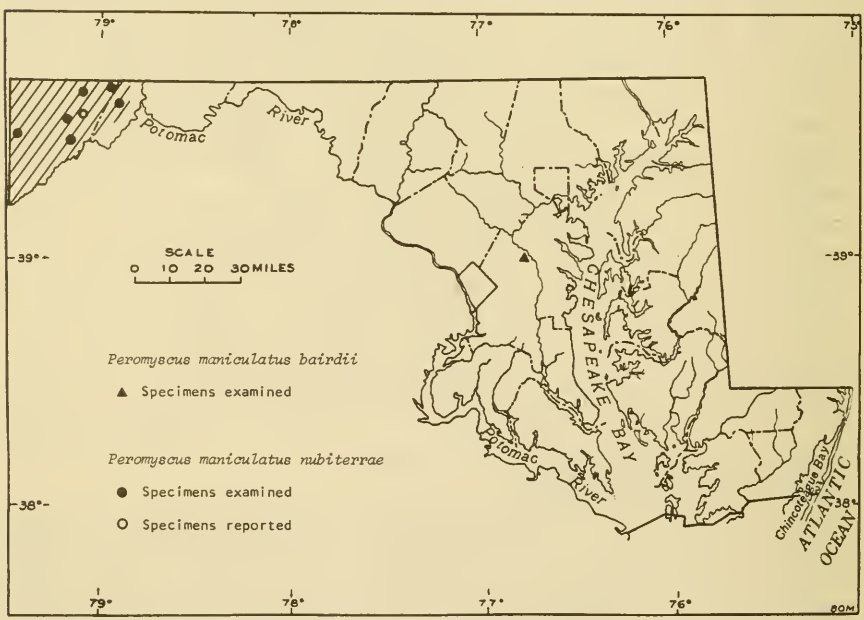

FIGURE 34.—Distribution of *Peromyscus maniculatus nubiterrae* and *P. m. bairdii*.

and their distinguishing characteristics are discussed in more detail under that species.

Measurements.—Thirteen adults from Finzel, Garrett County, have external measurements as follows: Total length 179.3 (172–190); tail 93.1 (82–102); hind foot 20.5 (20–22). Eleven adults from Finzel have the following cranial measurements: Greatest length 24.6 (24.3–25.3); zygomatic breadth 12.3 (11.7–13.3); interorbital breadth 3.7 (3.5–3.9); maxillary toothrow 3.3 (3.2–3.5).

Habitat and habits.—This subspecies prefers dense woods and is most abundant among mossy boulders and logs in moist spruce and fir forests at higher elevations. E. A. Preble (in field notes) gives information about where he took specimens in Garrett County. He says that they were common in a tract of hemlock woods about 3 miles east of Grantsville. One specimen was taken in a small strip of deciduous trees and shrubs adjoining a field where *Peromyscus leucopus* was also taken. At Finzel, at an elevation of about 2,600 feet, he found that these mice were abundant and inhabiting all sorts of situations from the dry hillsides and edges of fields to the deep hemlock swamps, while at Bittinger (elevation about 2,600 feet) they were abundant only in the deep woods.

This mouse nests in burrows under rocks and logs and sometimes in hollow trees. It is somewhat arboreal and may build tree nests as high as 50 feet above the ground (J. W. Bailey, 1946, p. 216). Two or three litters, of from two to seven young, are produced each season. Food consists of seeds, nuts, and berries, supplemented with insects, snails, and occasionally dead birds and other mice.

Specimens examined.—Allegany County: Frostburg, 1. *Garrett County:* Bittinger, 6; Finzel, 18; Grantsville, 16; Swallow Falls State Forest (near Muddy Creek Falls), 1.

Other records and reports.—Garrett County: New Germany (Coll. Nat. Hist. Soc. Maryland).

WHITE-FOOTED MOUSE

Peromyscus leucopus noveboracensis (Fisher)

[*Mus. sylvaticus*] *noveboracensis* Fisher, Synopsis Mammalium, p. 318, 1829.

Type locality.—New York.

General distribution.—From eastern and southern Ontario, east to Maine, south along the Atlantic coast into Virginia, West Virginia, and northern Kentucky, westward, south of Great Lakes, to eastern North Dakota, South Dakota, Nebraska, northeastern Oklahoma, and northwestern Arkansas.

Distribution in Maryland.—Occurs abundantly in all sections of the State.

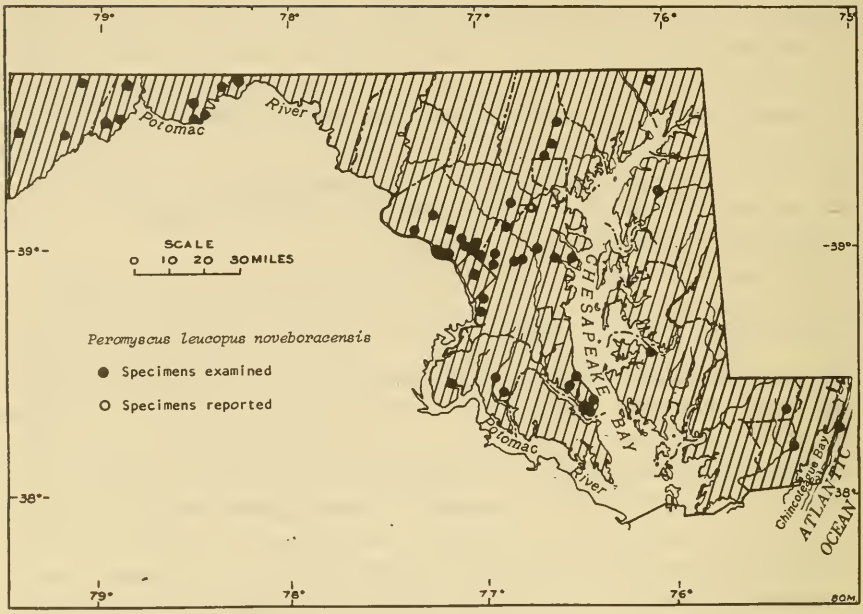

FIGURE 35.—Distribution of *Peromyscus leucopus noveboracensis.*

Distinguishing characteristics.—The white-footed mouse closely resembles the deer mouse (*Peromyscus maniculatus*), from which it may be distinguished as follows:

From *Peromyscus m. bairdii* it differs in being larger, longer tailed, lighter and more brightly colored with more reddish on sides and back, and in having noticeably larger ears and feet; the tail is less distinctly bicolored.

Cranially, *P. l. noveboracensis* is larger than *P. m. bairdii*, and the incisive foramina are differently shaped. These foramina are anteriorly constricted in *noveboracensis*, and open and evenly curved in *bairdii*. A detailed comparison of these two forms is given by Stickel (1951, p. 25–32).

From *Peromyscus m. nubiterrae*, *P. l. noveboracensis* differs in being larger, shorter tailed, (tail less than half the total length of the animal) and more brightly colored, with more reddish on sides and back. This color difference is subtle in individual specimens but becomes apparent when large series of both species are examined. The tail in *noveboracensis* is less distinctly bicolored than in *nubiterrae*.

Some specimens of *nubiterrae* and *leucopus* are so similar in external characteristics that only by a detailed examination of the skull can they be separated. The skull of *nubiterrae* is slender and elongated, the braincase considerably flattened, whereas cranially *noveboracensis* is broader and heavier with the braincase more inflated. As in *P. m.*

bairdii, the incisive foramina of *nubiterrae* are open and evenly curved, while in *noveboracensis* they are anteriorly constricted. The teeth in the latter form, even in juvenile animals, are noticeably larger and more robust than in *nubiterrae*.

Measurements.—External measurements of eight adults from Allegany County (Dans Mountain State Park, and vicinity of Oldtown) are as follows: Total length 174.4 (170–188); tail 76.2 (70–92); hind foot 21.1 (20–22); ear 15.7 (13–18). Nine adults from the same localities have the following cranial measurements: Greatest length 26.2 (26.0–26.7); zygomatic breadth 13.4 (12.7–14.0); interorbital breadth 4.1 (3.9–4.3); maxillary toothrow 3.6 (3.4–3.8).

Habitat and habits.—This species is primarily a woodland inhabitant, but is often found in brushy regions and sometimes in grassy areas that border woodlands. It is one of the most abundant mammals in Maryland. On Assateague Island their tracks have been observed even on the bare sand dunes a few yards from the ocean beach. Usually, however, this mouse will be found not more than 50 feet from woods or forests, of which it seems to prefer the deciduous woods, especially oak-hickory forest.

Nests are built almost anywhere. Although it apparently does not dig its own burrow, or make a trail, this mouse will utilize burrows or trails of other small mammals. Jackson (1961, p. 218) says that it seems to prefer a tree site for its nest, usually about 6 to 8 feet from the ground, but that he has found them in abandoned squirrel nests as high as 20 feet above ground. He says that often the nest is built in a hollow tree or limb, and that another favorite site is under an old stump or log. The nest itself is composed of soft material such as grass, leaves, or other vegetation. It is usually about 10 or 12 inches in diameter and 6 or 8 inches deep.

Breeding takes place in late February or early March, and the first litter is born in April. The gestation period is variable, but is usually between 23 and 25 days, and the litter size varies from one to seven, usually three to six, with four the most frequent number. Each female may produce as many as four litters during the breeding season.

The principal food for the species is seeds of various grasses, weeds, clover, small fruits, and grain as well as acorns and hickory nuts. Insects form a small portion of the diet as does green herbage. This mouse sometimes occupies houses, where it may be bothersome. On Assateague Island in 1957 and 1958, white-footed mice were inhabiting the houses and outbuildings, while house mice (*Mus musculus*) occurred in the woods and marshes, but apparently not in the houses.

Specimens examined.—Allegany County: Dans Mountain State Park, 13; Green Ridge, 4; Mount Savage, 11; Oldtown, 4 miles E,

31; Oldtown, 9 miles E, 12; Rawlings, 2; Sideling Hill Creek, 8. *Anne Arundel County:* Annapolis, 3 miles NW, 12; Priest Bridge, 4; South River (at U.S. Route 50), 10. *Baltimore County:* Lake Roland, 5; Loch Raven, 7; Notch Cliff, 1. *Calvert County:* Battle Creek (Cypress Swamp), 4; Cove Point, 3; Drum Point, 2; Scientist Cliffs, 1; Solomons, 2; Solomons, 3½ miles N, 17. *Charles County:* Nanjemoy Creek, 2; Newport, 6; Zekiah Swamp, 4. *Dorchester County:* Cambridge, 5. *Garrett County:* Cranberry Swamp, 7; Grantsville, 4; Swallow Falls, 2 miles S, 2; Swanton, 3. *Howard County:* Atholton, 6. *Montgomery County:* Burnt Mills, 2; Cabin John (vicinity of), 4; Cupids Bower Island (vicinity of), 5; Forest Glen, 1; Great Falls, 1; Kensington, 5; Linden, 2; Plummers Island, 4; Rockville (vicinity of), 6; Seneca Creek (at Clopper Road), 5; Silver Spring, 26; Takoma Park, 1; Woodside, 1. *Prince Georges County:* Anacostia River, NW Branch, 3; Bladensburg, 7; Branchville, 2; Broad Creek (Indian Head Bluff), 4; Collingwood (= Collington?) 1 mile S, 2; Hyattsville, 4; Lanham, 4; Laurel, 10; Oxon Hill, 12; Riggs Mill, 1; Riverdale, 3. *Washington County:* Bear Creek, just N of U.S. Route 40, 2. *Wicomico County:* Powellsville, 1. *Worcester County:* Snow Hill, 1 mile NE, 1; Ocean City, 5 miles S, 1. *District of Columbia:* 62.

Other records and reports.—Allegany County: LaVale (Coll. U. Md.). *Anne Arundel County:* Dorsey (U.S. Fish and Wildlife Service files). *Cecil County:* Rising Sun (U.S. Fish and Wildlife Service files). *Garrett County:* Muddy Creek Falls (Mansueti and Flyger, 1952, p. 250). *Kent County:* Chestertown (U.S. Fish and Wildlife Service files). *Prince Georges County:* Bowie (Lucille F. Stickel, 1946, p. 301).

Remarks.—Specimens from the Eastern Shore section (Cambridge, Powellsville, Snow Hill, and Assateague Island), as well as Virginia specimens from Accomack and Northampton Counties on the lower Delmarva Peninsula, are not typical *noveboracensis* but are somewhat darker in coloration, and smaller in size, and appear to be intergrades with *P. l. leucopus* (Rafinesque). The type locality of *P. l. leucopus* is in western Kentucky, which is also an area of intergradation. Maryland specimens from the Eastern Shore section are only slightly larger and paler than specimens from western Kentucky near the type locality of *P. l. leucopus*. Nevertheless, they are considerably different from *P. l. leucopus* from southern Louisiana (where the subspecies is best characterized) both in size and coloration, and are more closely related to *P. l. noveboracensis* from central New England where *noveboracensis* is best characterized) than to Louisianan *P. l. leucopus*.

EASTERN WOOD RAT

Neotoma floridana magister Baird

N[*eotoma*]. *magister* Baird, Mammals, in Repts. Expl. Surv. . . , 8 (1) : 498, 14 July 1858.

Type locality.—Cave near Carlisle, Cumberland County, or near Harrisburg, Dauphin County, Pa.

General distribution.—Appalachian Mountain region, from extreme western Connecticut and southern New York, south through western Virginia and Tennessee to the Tennessee River in northern Alabama, west to central Kentucky and northward to extreme southern Indiana.

Distribution in Maryland.—The Allegheny Mountain and Ridge and Valley sections; occurs east of the Blue Ridge Mountains in the Piedmont section along the cliffs and bluffs of the Potomac River to the vicinity of Washington, D.C. It may occur among the cliffs and bluffs of river valleys elsewhere in the Piedmont section.

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; size large; coloration grizzled grayish dorsally, with some buffy intermixture, paler and more buffy on sides; underparts and feet white; ears large and naked; tail long, hairy, and distinctly bicolored, black dorsally and white underneath; vibrissae very long, and black or white in coloration. The young are similar to the adults, but are grayer.

This species may be confused with the Norway rat, which it resembles superficially. It may be distinguished from that species by its larger naked ears, its much longer vibrissae, its longer, more hairy, and bicolored tail, and its softer, more grizzled grayish coloration. In addition, the molar teeth of the two species differ. In the eastern wood rat the crowns are flat, with the enamel thrown into prismatic folds; in the Norway rat the molars are tuberculate.

Measurements.—An adult male from 9 miles E of Oldtown, Allegany County, measures as follows: Total length 430; tail 188; hind foot 42; ear 30; greatest length of skull 56.2; interorbital breadth 6.8; length of nasals 21.5; length of molar toothrow 9.3.

Hamilton (1943, p. 306) gives the following external measurements for 10 adults from New York, Pennsylvania, and West Virginia: Total length 423 (405–441); tail 186 (170–200); hind foot 43.5 (40–46).

Habitat and habits.—The eastern wood rat prefers cliffs, rock slides, caves, and bare patches in the mountainous regions of the State. It ranges into the Piedmont section at least in the Potomac River Valley, where it lives in the cliffs and rocks that border the river. It may occur in the bluffs that border other rivers in the Piedmont section, and has been reported from Woodside, Montgomery County (Wetmore, 1923, p. 187). In the Potomac River Valley, it has been found as far south

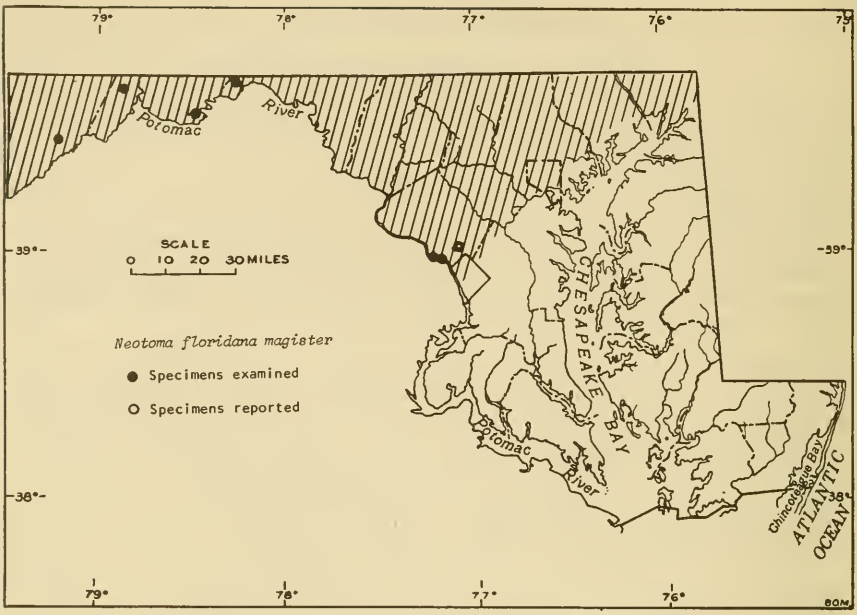

FIGURE 36.—Distribution of *Neotoma floridana magister.*

as Plummers Island, Montgomery County, and on the Virginia side of the river at Chain Bridge.

Wood rats were particularly abundant in the vicinity of Oldtown, Allegany County, in the fall of 1961, where virtually every rocky outcropping contained signs of them. They had taken up residence under the front porch of a hunting cabin 9 miles east of Oldtown, and the sounds of their activity could be heard all night. They are inquisitive animals, and one had thoroughly explored an automobile that was parked nearby, even crawling into the engine compartment, leaving tracks everywhere in the dust.

The eastern wood rat appears to have moved into Maryland's Piedmont section only within recent years. Wetmore (1923, p. 187) reports that although Plummers Island had been under observation by Washington naturalists since 1902, it wasn't until 1921 that the species was discovered to be resident there. It was known, however, to inhabit the cliffs along the Virginia side of the Potomac River as far south as Chain Bridge for many years before it was first reported from Plummers Island, and it seems probable that the Plummers Island population crossed over from Virginia during a winter when the Potomac was frozen over. Wetmore (1923) says that one was killed on Plummers Island on 25 June 1921, by Mr. W. R. Maxon, but was not preserved. On 26 September and 15 October 1921, two specimens were collected and preserved in the Biological Survey collection. In the

same year, five nests of this species were discovered beneath the cabin on the island.

Wetmore (1923) describes the nests of the eastern wood rat on Plummers Island as being composed of bits of finely shredded cedar bark and similar materials that formed a flattened mass 12 to 15 inches across with a small depression in the center. As it was warm weather the cavities were open above, but the walls were so arranged that they could be pulled out to form a domed covering if the need for greater warmth arose.

Wood rats eat practically any vegetation they can obtain, including fruits and berries, fungi, ferns, rhododendron, and a host of others. The species breeds from spring until fall, and as many as three broods may be raised annually. The gestation period is 30 to 36 days, and one to three young are usually born.

Specimens examined.—Allegany County: Mount Savage, 1 (Coll. U. Md.); Oldtown, 9 miles E, 1. *Garrett County:* Backbone Mountain, Savage River Dam Site, 2 (Coll. U. Md.). *Montgomery County:* Plummers Island, 2. *Washington County:* Bear Creek, just north of U.S. 40, 1 (Coll. U. Md.).

Other records and reports.—Montgomery County: Perry's Island (Wetmore, 1923: 187); Woodside (Wetmore, 1923: 187).

RED-BACKED MOUSE

Clethrionomys gapperi gapperi (Vigors)

Arvicola gapperi Vigors, Zool. Jour., 5: 204, 1830.

Type locality.—Between York [Toronto] and Lake Simcoe, Ontario, Canada.

General distribution.—Massachusetts south in the Appalachians to western Virginia and west through New York, northern Michigan, and southern Ontario to eastern Minnesota.

Distribution in Maryland.—Occurs on the cooler forested slopes in the Ridge and Valley and Allegheny Mountain sections.

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; cheek teeth rooted in adults; size medium; coloration of upper parts rusty red, becoming buffy on the sides and around the face; underparts buffy white; tail less than a third of total length of animal, and bicolored, blackish above, paler below.

This mouse may be distinguished from most other Maryland mice by its reddish coloration and short tail. It resembles the pine mouse, however, in both these characters, but differs in that the reddish coloration is confined to the dorsum, whereas in the pine mouse the reddish coloration extends onto the sides. In addition, the ears of the red-backed mouse are larger, the tail is considerably longer, and the fur is longer, coarser, and less mole-like.

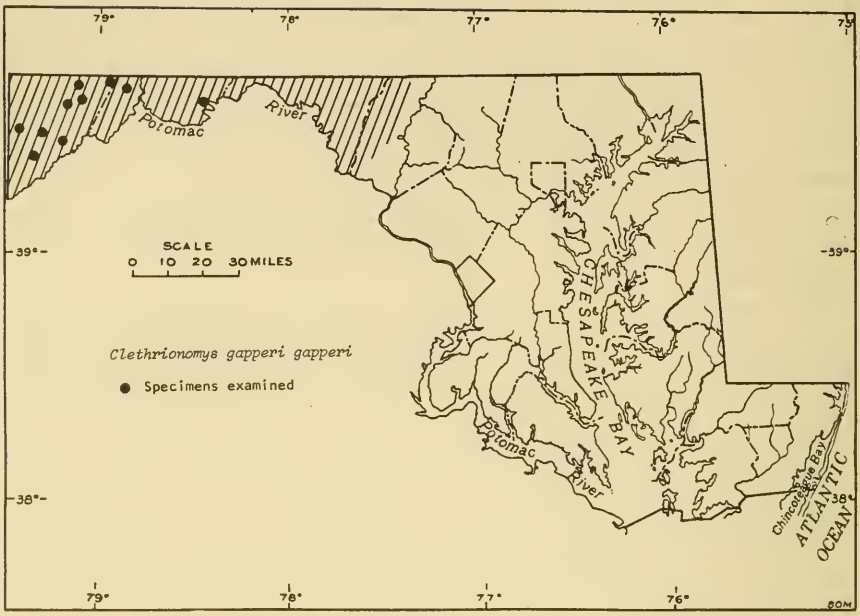

FIGURE 37.—Distribution of *Clethrionomys gapperi gapperi.*

Measurements.—Ten adults from Garrett County have the following external and cranial measurements: Total length 147.3 (140–155); tail 42.9 (38–48); hind foot 19.5 (19–20); condylobasal length of skull 24.9 (24.1–25.8); zygomatic breadth 13.3 (13.0–13.7); interorbital breadth 4.0 (3.9–4.2); length of molar toothrow 5.4 (5.2–5.6).

Habitat and habits.—This mouse prefers cool, damp, forested areas where it lives among the mossy rocks and rotten logs. In the northern part of its range it is widely distributed, but in Maryland it is restricted to the higher mountains, where it is locally abundant. Preble (field notes) took the red-backed mouse at Finzel on the border of a hemlock woods, and at Grantsville he found that it was very common in a tract of hemlocks 3 miles east of the town. It was also abundant in the mixed forest covering the steep slopes on the east side of the Castleman River, and in the hemlock woods near Bittinger. At Mountain Lake Park, Preble took a specimen among rocks in an oak woods, and at Swanton he trapped a very dark individual in deep hemlock woods. Bookhout tells me that he trapped one in Allegany County in a rock outcrop in a second-growth oak-hickory forest.

This species does not make elaborate tunnels, but will occupy those made by moles and shrews. Jackson (1961, pp. 227–228) has described a nest in detail. It was located among the rootlets of small trees and was some 3 inches in diameter. The nest was merely a small carpet of grass stems and a few particles of dead leaves and moss, the entire

bulk of which would be no larger than a man's thumb. Another nest was located at a depth of about 18 inches under a rotten elm stump. It was situated on top of the soil underneath a root of the stump, and was 4 inches in diameter and about 1 inch in depth, slightly hollow and without cover other than the log above. It was composed of small pieces of dry leaves, bark, hazelnut shells, hemlock cones, twigs, dry sphagnum, and green moss.

According to Hamilton (1941, p. 259), in New York State about three-fourths of the food of this species is composed of green vegetation. In addition, a large part of the diet consists of nuts and seeds. Insects are not as often eaten as they are by white-footed mice.

The red-backed mouse does not hibernate, but it does actively gather stores in the fall in preparation for winter. The breeding season is protracted, beginning in the late winter or early spring and extending well into fall. One litter follows another during the breeding season, and from two to eight young comprise a litter. The gestation period is 17 to 19 days.

Specimens examined.—Allegany County: Mount Savage, 6 (Coll. U. Md.); Town Hill Mountain, near beacon light, 1 (Coll. U. Md.). *Garrett County:* Bittinger, 7; Cranberry Swamp, 4 (Coll. U. Md.); Finzel, 5; Grantsville, 3 miles E, 15; Mountain Lake Park, 1; Swallow Falls State Forest (near Muddy Creek Falls), 1; Swanton, 1; Thayerville Swamp, 2 (Coll. U. Md.); Wolf Swamp, 1.

Remarks.—Maryland *C. g. gapperi* average somewhat darker and slightly larger than specimens of this subspecies from Ontario and central New York. They appear to be intergrades between *C. g. gapperi* and *C. g. carolinensis* but are more closely related to the former. The specimen collected by Preble in the deep hemlock woods at Swanton is as dark and large, however, as typical *carolinensis.*

MEADOW VOLE

Microtus pennsylvanicus (Ord)

Two races of this widespread and abundant small mammal are recognizable in Maryland. They are:

Microtus pennsylvanicus pennsylvanicus (Ord)

Mus pennsylvanicus Ord, in Guthrie, a new geogr., hist., comm. grammar . . . Philadelphia, 2d Amer. ed., 2: 292, 1815.

Type locality.—Meadows below Philadelphia, Pa.

General distribution.—From Quebec and New Brunswick, south into Georgia, and west into Nebraska, South Dakota, and North Dakota.

Distribution in Maryland.—Distributed in the Piedmont, Ridge and Valley, and Allegheny Mountain sections. Intergrades with *Microtus*

p. nigrans in the Eastern Shore and Western Shore sections, and is replaced by that subspecies in the southern Eastern Shore and southeastern Western Shore sections. (See fig. 38.)

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; molar teeth rootless and persistently growing; coloration of upperparts dull chestnut brown, darkest along the middle of the back; underparts grayish white, or buffy white; feet grayish brown; tail dusky above, paler below, fur overlaid with coarse guard hairs; tail less than a third of total length of animal.

This vole is similar in appearance to the red-backed mouse (*Clethrionomys gapperi*), but is larger and more brownish in coloration, and lacks the red dorsal band. It is also similar in appearance to the pine vole (*Pitymys pinetorum*) but has coarser pelage, bigger ears, and a longer tail. It differs from the southern bog lemming (*Synaptomys cooperi*) in its coarser, shorter pelage and much longer tail, and in lacking grooved upper incisors.

Measurements.—Eleven adults from the vicinity of Oldtown, Allegany County, have the following external and cranial measurements: Total length 169.2 (161.0–187.0); condylobasal length of skull 28.5 (28.1–29.0); zygomatic breadth 15.4 (14.8–15.9); interorbital breadth 3.6 (3.4–4.0); maxillary toothrow 6.9 (6.5–7.3). Males average somewhat larger than females.

Habitat and habits.—This vole is numerous in fields and meadows throughout the State. It is also common in marshes and similar areas with heavy growth of grass; occasionally it is found in orchards and open woodland if the ground cover is grassy. This is one of the most abundant mammals in Maryland.

Meadow voles construct extensive runways on the surface of the ground. These runways are about 1½ inches in diameter and run in a network under the cover of dead grass. They are sometimes the only sign of the presence of these voles in an area. If the runway is fresh and is being used, there will generally be droppings and cut pieces of grass at various intervals along it. The nest of the meadow vole is usually constructed on the surface of the ground in one of the runways. It is bulky, generally about 5 or 6 inches in diameter and 3 or 4 inches deep, usually covered, but sometimes not.

The meadow vole is active both day and night. It is cyclic in nature and the reproductive habits vary from year to year (Hamilton, 1937). It is polyestrous and may breed the year round, although in Maryland there is a tendency not to breed during the coldest part of winter. The females reach puberty and begin to breed at 25 days of age, and from six to eight young generally comprise a litter. The gestation period in this species is 21 days, or a little less, and as many as 17 litters may be produced in a year.

The food of the meadow vole consists chiefly of fresh grass, sedges, grains, and seeds. Green vegetation comprises the major portion of its diet in the spring and summer, while in the fall, grains and seeds are an important commodity. In winter, bark and roots of shrubs and trees are sometimes consumed.

Hamilton (1943, p. 327) says that the meadow vole is of great economic importance. By girdling fruit trees and nursery stock it causes monetary loss to the horticulturist. The amount of forage crops it consumes, while difficult to measure, is in the aggregate a very great loss to the farmer. It does, however, perform a useful function in providing predatory birds and mammals with an abundant source of food.

Specimens examined.—Allegany County: Cumberland, 2; Mount Savage, 8; Oldtown, 4 miles E, 19; Oldtown, 9 miles E, 74; Sideling Hill Creek, 3. *Anne Arundel County:* Annapolis, 1 mile W, 6; Annapolis, 3 miles W, 4; Annapolis, 4 miles W, 2; Lake Shore area, 1. *Baltimore County:* Loch Raven, 2. *Charles County:* Nanjemoy Creek, 2; Newport, 5. *Garrett County:* Finzel, 1; Grantsville, 1; Mountain Lake Park, 2. *Howard County:* Atholton, ½ mile S, 5; Long Corner, 1. *Montgomery County:* Cabin John Bridge, 1 mile N, 1; Kensington, 1; Rockville, 2.3 miles NE, 3; Seneca, 1½ miles NW, 26; Seneca, 2.9 miles W, 52; Silver Spring (vicinity), 5. *Prince Georges County:* Collingwood (=Collington?), ½ mile S, 2; Hyattsville, 10; Lanham, 1; Laurel, 30; Oxon Hill, 11; Riggs Mill, 1. *Queen Annes County:* Parson Island, 2. *District of Columbia:* 91.

Other records and reports.—Allegany County: Dans Mountain (Coll. U. Md.); La Vale (Coll. U. Md.); McCoole (Coll. Carnegie Museum). *Anne Arundel County:* Dorsey (U.S. Fish and Wildlife Service files). *Baltimore County:* Bare Hills–Lake Roland area (Bures, 1948, p. 67); Patapsco State Park (Hampe, 1939, p. 6). *Garret County:* Cranberry Swamp (Coll. U. Md.). Cranesville Pine Swamp (Mansueti, 1958, p. 83); Cunningham Swamp (Coll. U. Md.). *Prince Georges County:* Patuxent Research Center (Herman and Warbach, 1956, p. 87).

Remarks.—This subspecies intergrades with *Microtus p. nigrans* in the Eastern Shore and Western Shore sections. Specimens from the northern portion of these sections (Parson Island, Annapolis vicinity, Laurel, Oxon Hill) are, however, clearly referable to *M. p. pennsylvanicus*, as is a small series from Newport, in the south central Western Shore section.

Microtus pennsylvanicus nigrans Rhoads

Microtus pennsylvanicus nigrans Rhoads, Proc. Acad. Nat. Sci. Phila., 49 : 307, 18 June 1897.

Type locality.—Currituck, Currituck County, N.C.

General distribution.—Near the coast from southeastern Maryland to northeastern North Carolina.

Distribution in Maryland.—Southern Eastern Shore section at least as far north as Cambridge, Dorchester County, and southeastern Western Shore section in Calvert and probably St. Marys Counties. This subspecies intergrades with *Microtus p. pennsylvanicus* in the central portion of the Western Shore section and in the northern part of the Eastern Shore section.

Distinguishing characteristics.—Similar to *Microtus p. pennsylvanicus* except that it is somewhat larger and has a darker coloration, almost black in some pelages.

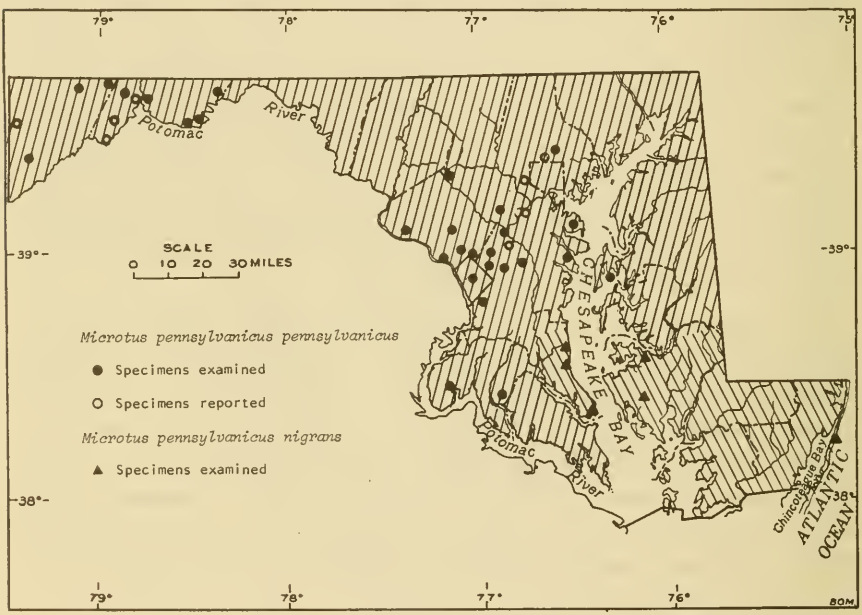

FIGURE 38.—*Distribution of Microtus pennsylvanicus pennsylvanicus* and *M. p. nigrans.*

Measurements.—External and cranial measurements of seven adults from Drum Point, Calvert County, are as follows: Total length 173.1 (168–184); tail 47.8 (42–52); hind foot 22.6 (22–23); ear 14.3 (12–16); condylobasal length of skull 29.1 (28.1–30.5); zygomatic breadth

15.9 (15.4–16.6); interorbital breadth 3.8 (3.5–4.0); maxillary toothrow 6.8 (6.6–6.9).

Habitat and habits.—In the southern Eastern Shore section, this subspecies abounds in the dryer portions of brackish and salt marshes along the Atlantic seacoast and the Chesapeake Bay. It is probably the most abundant mammal occurring on Assateague Island. As an example of its numbers on this outer barrier island, it may be noted that in a single night in the spring of 1956, 60 specimens were taken in 100 traps set in tall grass and myrtle on the edge of a fresh water impoundment on the Virginia portion of the island a few miles south of the Maryland line. It also lives in the marshes of the Blackwater National Wildlife Refuge in Dorchester County where it builds nests in muskrat houses (Harris, 1953).

In the Western Shore section, in Calvert County, this vole has been taken in dry meadows and brushy fields.

The habits of this subspecies apparently differ in no essential respect from those of *Microtus p. pennsylvanicus*.

Specimens examined.—Calvert County: Breezy Point, 1; Drum Point, 12; Scientists Cliffs Road (1 mile E Route 2), 2. *Dorchester County:* Blackwater National Wildlife Refuge, 5; Cambridge, 5. *Worcester County:* Assateague Island, 4 and 5 miles S Ocean City, 10.

PINE VOLE

Pitymys pinetorum scalopsoides (Aud. and Bachman)

Arvicola scalopsoides Audubon and Bachman, Proc. Acad. Nat. Sci. Philadelphia, 1: 97, October 1841.

Type locality.—Long Island, N.Y.

General distribution.—Northeastern United States, from central New England, south to Virginia and western North Carolina, west to Illinois and Wisconsin.

Distribution in Maryland.—Common in all sections of the State.

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; molar teeth not rooted, and grow persistently; tail very short, buffy brown above, lighter below; ears very short, and hidden in fur; pelage short, soft and glossy, almost mole-like; coloration russet to chestnut brown on dorsum, becoming lighter on sides; underparts grayish buff; feet grayish brown.

This species resembles the meadow vole (*Microtus pennsylvanicus*) from which it may be distinguished by its shorter tail, shorter ears, and finer, more russet pelage. It differs from the red-backed mouse (*Clethrionomys gapperi*) in that the reddish coloration of the dorsum extends onto the sides and is not confined to a band on the dorsum; smaller ears; shorter tail; fur shorter, softer and more mole-like.

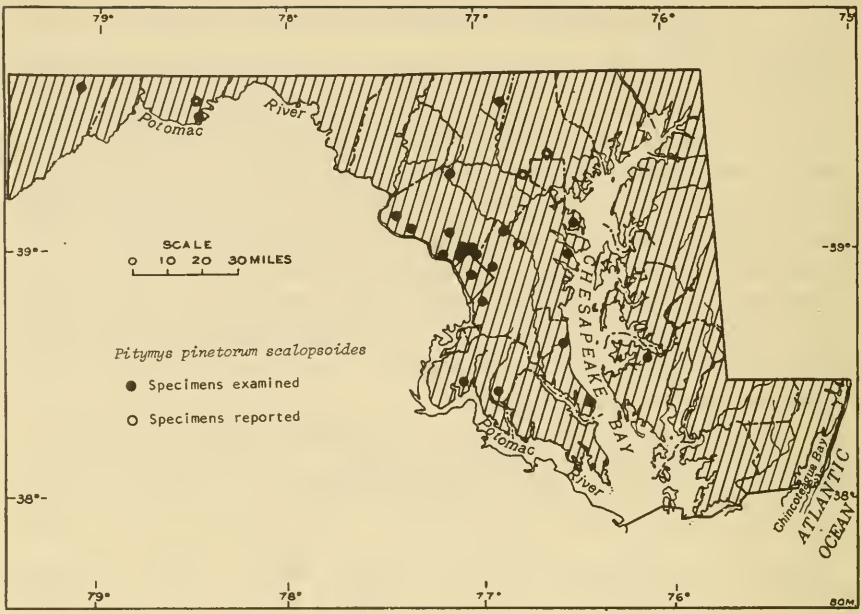

FIGURE 39.—Distribution of *Pitymys pinetorum scalopsoides*.

From the southern bog lemming (*Synaptomys cooperi*) this species may be readily distinguished by the lack of grooves on the upper incisors.

Measurements.—Ten adults from the District of Columbia have the following external measurements: Total length 124.8 (120–131); tail 22.1 (15–25); hind foot 16.6 (16–18). Eleven adults from the District of Columbia have cranial measurements as follows: Condylobasal length 24.9 (24.2–25.9); zygomatic breadth 15.5 (14.2–16.3); interorbital breadth 4.2 (3.9–4.6); length of maxillary toothrow 6.1 (5.8–6.5).

Habitat and habits.—This species is not particular with regard to habitat preference, being found in old fields, wood borders, and cultivated fields, especially in loose sandy soils. It is often found in old apple orchards where the soil is mellow and sandy, and the grass and weeds have been allowed to grow, forming a heavy protective carpet of vegetation. The fallen apples also provide the mice with food in autumn, and the bark of apple roots supply a favorite winter food. Contrary to its name, the pine vole is seldom found in pine woods in Maryland.

Hamilton (1938, pp. 163–170) in his life history study of the species says that the animal threads its way just beneath the thick carpet of leaves which forms a ceiling to its burrow. Rarely the pine vole tunnels to a depth of a foot or more, but by far the greater number

of burrows are shallow, descending to a depth of only 3 or 4 inches. In orchards it tunnels its way to fallen apples, and then burrows up from underneath to feed on the fruit. These mice seldom leave their subterranean burrows.

The nest of the pine vole is globular in shape, and composed of almost any material the animal can procure, generally dead leaves and grasses. The nest may be just below the ground surface, or, occasionally under some shallow-rooted stump. Usually there are three or four exits.

This species feeds largely on roots and tubers, bulbs, and the bark of trees and shrubs. It seldom eats green vegetation, seeds, or most kinds of fruit, although it does relish apples and pears. Generally, considerable quantities of roots and tubers, which presumably are utilized as the bulk of the winter food, are stored in its burrows. Pine voles often are responsible for depredations in orchards, where they frequently girdle apple trees severely.

This species is cyclic, and according to Hamilton (1938, p. 166) its reproductive behavior undoubtedly varies from year to year as does that of *Microtus*. The breeding season is from early March to mid-November, and small litters of from two to four young are produced. The gestation period in all probability approximates the 21 days of *Microtus*.

Specimens examined.—Allegany County: Oldtown, 9 miles E, 4. *Anne Arundel County:* Annapolis, 3 miles NW, 2; Lake Shore area, 2. *Calvert County:* Plum Point, 2 miles W, 1; Solomons Island, 3½ miles N, 1. *Carroll County:* Hampstead, 1. *Charles County:* Newport, 3; Port Tobacco, 3 miles SW, 1. *Dorchester County:* Cambridge, 3. *Garrett County:* Grantsville, 1. *Howard County:* Long Corner, 1. *Montgomery County:* Chevy Chase, 1; Kensington, 2; Montgomery Knolls, 1; Plummers Island, 5; Poolesville, 1 mile NE, 1; Rockville, 2.3 miles NE, 10; Seneca, 1.3 miles W, 1; Seneca, 1½ miles NW, 1; Silver Spring, 1; Takoma Park, 1; Woodside, 5. *Prince Georges County:* Bladensburg, 1; Laurel, 9; Oxon Hill, 1. *District of Columbia:* 61.

Other records and reports.—Allegany County: Green Ridge (Coll. U. Md.). *Baltimore County:* Bare Hills–Lake Roland area (Bures, 1948: 68); Patapsco State Park (Hampe, 1939: 7). *Prince Georges County:* Patuxent Research Center, along Patuxent River (Stickel, Lucille F., 1948: 506).

MUSKRAT

Ondatra zibethicus macrodon (Merriam)

Fiber macrodon Merriam, Proc. Biol. Soc. Washington, 11: 143, 13 May 1897.

336-897 O—69——8

Type locality.—Lake Drummond, Dismal Swamp, Norfolk County, Va.

General distribution.—Reported from Chester County, Pennsylvania, south in the Coastal Plain and Piedmont to the lower Cape Fear drainage of southeastern North Carolina.

Distribution in Maryland.—Eastern Shore, Western Shore, and Piedmont sections.

Muskrats are especially abundant in the fresh-water and brackish marshes of the Eastern Shore section. The subspecies *macrodon* intergrades with *O. z. zibethicus* in the Piedmont section and is probably replaced by that subspecies in the Ridge and Valley and Allegheny Mountain sections.

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; tail long and laterally compressed; hind feet partially webbed; ears small and almost hidden in fur; pelage dense, underfur soft and thick, overlaid with long smooth guard hairs; usual coloration a rich brown, with considerable bright russet to red tinge, darker on head, nose, and back; sides grayish brown to russet; underparts considerably lighter, varying from grayish drab to bright cinnamon rufous.

There is a black color phase of this subspecies which in some Maryland marshes runs as high as 65 percent of the population (Dozier, 1948*b*, p. 393). These animals are not uniformly black, but have a modified agouti pattern shown in the lighter ventral surfaces and on the lower side areas where the hairs are subapically banded with

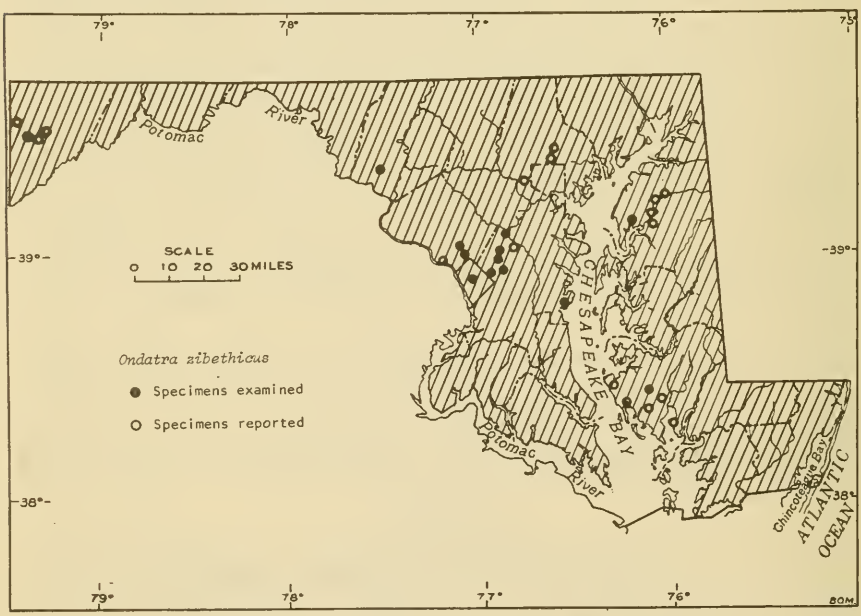

FIGURE 40.—Distribution of *Ondatra zibethicus*.

yellow. The dorsum, however, is a uniform glossy black with no hairs banded with red and yellow. Rarely an albinistic individual is encountered, and Dozier (1948*b*, p. 394) has reported upon a nonalbino white mutation ("Maryland white") occurring in some of the marshes in Dorchester County, and fawn colored mutants from the vicinity of Chestertown, Kent County.

The muskrat is readily distinguished from other Maryland rodents by the combination of its aquatic habits, large size, and laterally compressed tail. The beaver, which the muskrat resembles in aquatic habits, is larger and has a broad, horizontally compressed tail.

Measurements.—External measurements of an old male and two young adult females from Laurel, Prince Georges County, are as follows: Total length 675, 600, 570; tail 280, 275, 266; hind foot 87, 86, 79. Cranial measurements of 11 adults from Laurel are: Condylobasal length 67.6 (63.9–72.2); zygomatic breadth 41.8 (39.8–44.5); least interorbital breadth 5.9 (5.0–6.6); length of maxillary toothrow 16.1 (14.9–17.2).

Dozier et al. (1948, p. 180) found that the average weight of 13,421 male muskrats trapped on the Blackwater National Wildlife Refuge, Dorchester County, was 2 pounds 4 ounces, and the average weight of 10,090 females was 2 pounds 2 ounces. Adult males varied in weight from 6 ounces to 4 pounds, and females from 6 ounces to 3 pounds 12 ounces.

Habitat and habits.—Muskrats are most abundant in the extensive marshes that line the Chesapeake Bay. Elsewhere in Maryland they are found in streams that wind through pastures, and in swamps.

The muskrat is essentially vegetarian, but occasionally will make use of animal food such as fish, mussels, insects, crayfish, and snails. Martin et al. (1951, p. 236) report that at the Patuxent Research Center near Laurel, the most important plant material eaten is burreed, cutgrass, arrowhead, waterlily and panicgrass. Smith (1938, p. 12) found that muskrats in Dorchester County would eat, to some extent, almost any plant found in the marshes there. Certain favorities, however, form their staple diet, and no area lacking these will support a large muskrat population. Three square sedge and broadleaf and narrowleaf cattails constitute four-fifths of the animal's diet, and all parts of these plants are eaten at one time or another during the year. Other foods that are at times utilized by the muskrat in the Dorchester marshes are saltmarsh, wild reed, saltgrass, beak-rush, spikerush, big cordgrass, wild millet, and sweet sedge. Also occasionally eaten are saltmarsh fleabane, marshmallow, waterlily, dodder, iris, waxmyrtle, small pine trees, and poison-ivy. Smith found that Dorchester County muskrats sometimes consumed turtles, blue crabs, fish (chiefly sluggish kinds such as carp), salt-water mussels, and possibly dead birds.

In the Maryland marshes, muskrats are active at all hours, in the spring and throughout the summer.

Muskrat homes are of two general types depending on the topography of the area in which they live. In the uplands they dig burrows into the banks of streams and other bodies of water, while in the marshes they build dome-shaped structures. The entrance hole to a bank burrow is always below the normal level of water. The burrow turns upward above water level and ends in a nest of grass. The dome-shaped structures that they build in the marshes may be as much as 7 or 8 feet in diameter and more than 4 feet high. They are constructed of stalks, roots, and peaty remains of plants and are built on or around a firm foundation such as a stump or the base of a tree. Each house contains one or more nests from which passages lead to plunge holes in the floor. These holes in turn lead to underground tunnels that connect with the surface several feet from the house.

Muskrats are primarily aquatic and construct elaborate canals, 6 inches to a foot wide, and sometimes a foot or more deep, which are not visible when the water is high. Those canals which are used as main arteries of travel are always wider and deeper than those used only as temporary leads made in search of food. In dry areas the muskrats use surface trails concealed in the grass that lead in all directions, and except for size, resemble those made by the meadow mouse.

In addition to surface canals and trails, muskrats construct elaborate systems of underground burrows and tunnels that spread out in all directions and are connected with the surface and the canals by plunge holes scattered at convenient intervals.

Smith (1938, p. 16) found that in Maryland the muskrat may breed in any month with the possible exception of November and December. Most of the young are born from mid-April to mid-September. Most Maryland trappers report that there are three litters a year, but Smith (1938, p. 16) was only able to obtain two a year in pen-raised animals. The number of young is variable; in the Maryland investigations conducted by Smith, the number averaged 4.4, seven being the most found in any one uterus. The gestation period appears to be about 29 or 30 days, and muskrats probably first breed at the age of 1 year.

The population of muskrats in Maryland marshes apparently has been decreasing since 1939. The number of muskrats trapped in the marshes from year to year may not reflect the actual muskrat population since many factors such as food, predation, salinity, and breeding, which are not readily observable, together with the value of pelts, act together to affect muskrat abundance, and may be different from year to year. Furthermore, these factors may cause different reactions on the part of the muskrat populations at different levels of abundance. Nevertheless, trapping records probably give an adequate index of the

larger fluctuations in population level in Maryland. With this in mind, Harris (1952, p. 13) lists the muskrat catch on approximately 600 acres of marsh on the Nanticoke River, Dorchester County. In 1937, the total catch of muskrat on this marsh was 2,417 animals (4.0 animals per acre). By 1950 the catch on this same marsh had dropped to 150 animals, or 0.2 animals per acre. On a Statewide level, the total catch of muskrat was estimated at 2 million in 1938. In 1949, when Maryland first began to keep accurate records of the muskrat catch, only 228,548 animals were reported trapped throughout the State. By 1957 this figure had dropped to a low of 112,348 muskrats. The 1967–68 catch was reported as 139,000.

These figures show that the muskrat population has been experiencing a decline over the past 25 years, and since the muskrat is an economically important animal, there has been considerable speculation and research devoted to the reason, or reasons, for this decline. Hardy (1950, pp. 8–9, 27) records the opinions of the trappers themselves regarding this decline, which includes such ideas as there being a definite ecological relationship between muskrats and domestic hogs. These trappers stated that with the fencing in of property in Dorchester County the hogs were no longer able to root in the marshes and, hence, the ecological relationship of the two species was destroyed and the muskrat population declined. Another theory maintained by some of the trappers is that owing to various causes there has been a great increase in the number of eels in Dorchester County waters and that eels enter the muskrat houses and consume young. Other ideas are that the muskrat decline is due to increased predation by raccoons and foxes; a "dreadful disease"; floristic changes; "trapping under" (placing the trap in underground leads); and high water. Hardy (1950, p. 27) notes that some of these factors may have been operative, but that it can safely be assumed that the diminishing population of the muskrat in Dorchester County has been brought about by a combination of ecological and environmental changes rather than by any single factor. Harris (1952, p. 36) points out that his study on Dorchester County muskrats did not answer the question why there has been a decline in their numbers, but it did show that the combination of predation and a reduced capacity of the marsh to support muskrats may prevent a rapid increase in the muskrat population.

Specimens examined.—Anne Arundel County: Broadwater, 1. *Dorchester County:* Blackwater National Wildlife Refuge, 8. *Frederick County:* Jefferson, 1. *Montgomery County:* Forest Glen, 1; Kensington, 1; Sligo Branch, 1. *Prince Georges County:* Beaverdam Creek, 1; Beltsville, 1; Branchville, 3; Lanham, 2; Laurel, 147. *District of Columbia:* 6.

Other records and reports (from Dozier, 1948*b*, unless otherwise noted).—*Baltimore County:* Bare Hills–Lake Roland area (Bures, 1948, p. 68); Loch Raven (Kirkwood, 1931, p. 317); Patapsco State Park (Hampe, 1939, p. 7). *Dorchester County:* Best Pitch Ferry; Elliotts Island; Fishing Bay; Joe's Point; Robbins, near; Taylors Island; World End Creek, near Golden Hill. *Garrett County:* Piney Run, near Piney Dam (trapping record, Maryland Nat. Res. Inst.); Pawn Run, as it enters Deep Creek (trapping record, Maryland Nat. Res. Inst.). *Kent County:* above and below Chestertown, on the Chester River; Chestertown (specimens in Acad. Nat. Sci. Phila. collection); Fairlee Creek near its Chesapeake Bay Mouth. *Montgomery County:* Mainland across from Plummers Island (Goldman and Jackson, 1939, p. 133). *Prince Georges County:* Patuxent Research Refuge (Uhler & Llewellyn, 1952, p. 81). *Queen Annes County:* Booker's Wharf.

Remarks.—I have not been able to examine specimens from the Ridge and Valley and the Allegheny Mountain sections, but one specimen I examined from Jefferson, Frederick County, just to the east of the Blue Ridge Mountains, is clearly an intergrade with *Ondatra z. zibethicus* in size and coloration, and almost near enough to typical *zibethicus* to be assigned to that subspecies. On the basis of this specimen, and because of the known distribution of *O. z. zibethicus* in Virginia and Pennsylvania, the muskrats of the Ridge and Valley and Allegheny Mountain sections probably are referable to the subspecies *zibethicus*. This subspecies appears to intergrade with the Coastal Plain subspecies *macrodon* throughout most of the upper Piedmont section.

Published reports of this species in western Maryland are by Browning (1928, p. 213) who saw muskrats around 1825 in the vicinity of Deep Creek Lake in Garrett County, and by Mansueti, (1958, p. 83), who observed them in Cranesville Swamp, Garret County, in the 1950's. The species is present in suitable streams and ponds throughout the Ridge and Valley and Allegheny Mountain sections at the present time, and according to Flyger (in verbis, 22 June 1964) trappers report that they are not uncommon.

Ondatra z. zibethicus differs from *O. z. macrodon* in its darker pelage (in normal color phase), and in its smaller size. It is of interest to note that Merriam in his original description of *macrodon* (specimens from Dismal Swamp, Virginia) considered the subspecies to be a much darker form than *zibethicus*. Merriam's specimens, however, were mostly dark phase animals, and as Hollister (1911, p. 18) has shown, *macrodon* (in normal color phase) is actually a lighter and brighter colored subspecies than *zibethicus*.

SOUTHERN BOG LEMMING

Synaptomys cooperi stonei Rhoads

Synaptomys stonei Rhoads, Amer. Nat., 27: 53, January 1893.

Type locality.—May's Landing, Atlantic County, N.J.

General distribution.—Southern Appalachians of eastern Kentucky and Tennessee, western North Carolina and Virginia and western Maryland to the Atlantic Coastal Plain of Maryland, Delaware, and New Jersey, and northward to Connecticut and coastal Massachusetts.

Distribution in Maryland.—Statewide in distribution. The most southeasterly record for the subspecies *stonei* is in Worcester County (Poole, 1943, p. 103).

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; size medium; tail short; fur rather long and shaggy; head broad; ears short, rising slightly above the fur; upper incisor teeth grooved. Coloration of upper parts brown to chestnut, grizzled in appearance; underparts silvery, with no sharp line of demarcation on the sides; tail grayish black, not sharply bicolored; feet brownish black.

This is the only short-tailed mouse in Maryland which has grooved upper incisors, and may thus be distinguished from all others. Cranially, the southern bog lemming has a shorter rostrum than any other Maryland mouse.

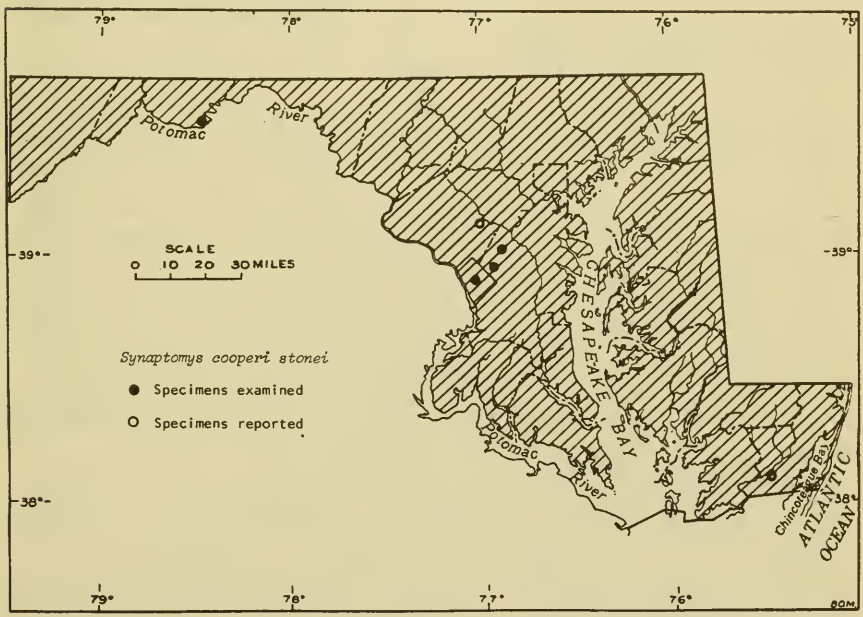

FIGURE 41.—Distribution of *Synaptomys cooperi stonei*.

Measurements.—External measurements of five adults, and cranial measurements of six adults from Laurel, Prince Georges County, are as follows: Total length 127.4 (120–135); tail 21.2 (18–23); hind foot 19 (18–20); greatest length of skull 24.7 (24.3–24.9); zygomatic breadth 17.0 (16.5–17.5); interorbital constriction 2.9 (2.7–3.1); length of maxillary toothrow 7.5 (7.4–7.8).

Habitat and habits.—This species has a preference for sphagnum bogs, and this is where most Maryland specimens have been collected. It is sometimes found, however, in woodland habitats, including beach-maple, oak-hickory, and pine. Specimens have even been taken in grassy areas, orchards, weedy fields, and marshes, and in shocked corn.

According to Conner (1959, p. 171) the chief requirement of *Synaptomys* seems to be the presence of green succulent monocotyledonous plants, primarily sedges and grasses, which are its main source of food.

This species may breed throughout the year, although Conner (p. 203) found that in southern New Jersey there was a spring peak in the breeding cycle, with some breeding continuing through summer and autumn. Poole (1943, p. 103) found a lactating female in Worcester County, Md., in late November. Conner (p. 202) found that litters of from two to five were usual for the species, although a single embryo is not uncommon, and as many as seven young have been reported. His data suggest that in the spring and summer females produce a litter every 67 days.

Wherever the southern bog lemming occurs, it is found in company with other small mammals such as red-backed mice, deer mice, shrews, and moles, and it often occupies the same burrows as these others. The nests are constructed of shredded grasses and sedges and are often concealed some distance beneath the ground. Less often, they are placed directly on the ground where there is sufficient ground cover. Conner (p. 227) found that most of the nests in southern New Jersey were located just under the surface, concealed in either hemlock or moss or in other elevated mounds in the bogs. Most of the nests were balls of dry shredded leaves of sedge, and had two entrances. The diameters ranged from 3½ to 6 inches, and the hollow spaces within the nests averaged about 2½ inches.

Specimens examined.—Allegany County: Oldtown, 9 miles E, 1. *Prince Georges County:* Beltsville, 1; Beltsville, 2½ miles W (sphagnum bog), 5; Hyattsville, 8. *District of Columbia:* 1.

Other records and reports.—Montgomery County: Sandy Springs [skull removed from stomach of red-tailed hawk] (Bailey, 1923, p. 118). *Worcester County:* Snow Hill, 6 miles SW (Poole, 1943, p. 103).

Remarks.—The specimen from 9 miles E of Oldtown, Allegany County, is somewhat smaller in size and less grizzled in coloration than those from farther east in the State. This animal may represent an intergrade in these characters with *S. c. cooperi*, the subspecies distributed to the north of *stonei*, or may actually be referable to that form. As Wetzel (1955, p. 12) has pointed out, however, the ranges of all measurements in these two subspecies overlap, and the variation in coloration within only one sample of *cooperi* for one season is much greater than between the various subspecies of *S. cooperi*. This illustrates the difficulty in assigning individual specimens to subspecies. Because of this, the specimen from Allegany County is provisionally assigned to *S. c. stonei*, the range of which is herein considered to encompass the entire State. When more specimens from the Piedmont and the Ridge and Valley sections become available for study, however, it may be found that *S. c. cooperi* is distributed in those sections, and that the specimen from Allegany County should properly be assigned to that race.

Family CAPROMYIDAE (hutias and coypus)

NUTRIA

Myocastor coypus (Molina)

Mus coypus Molina, Sagg. Stor. Natur. Chili, p. 287, 1782.

Type locality.—Rivers of Chile.

General distribution.—Ranges widely over southern South America; introduced into the United States in the 1930's, and now is established in the wild in at least 16 states.

Distribution in Maryland.—A few nutria are established in the Dorchester County marshes.

Distinguishing characteristics.—Teeth 1/1, 0/0, 1/1, 3/3, = 20; size large (sometimes attaining a weight of 21 lbs.); pelage consisting of 2 types of hair, dense underfur, and long glossy overlying guard hairs; coloration rich brown or chestnut on dorsum, paler underneath; tail long and cylindrical; middle toes of hind feet connected by a basal web.

This species superficially resembles the muskrat, from which it may be readily distinguished by its larger size, cylindrical as opposed to laterally compressed tail, and greater number of teeth.

Measurements.—An adult male and female from the Blackwater National Wildlife Refuge, Dorchester County, measure externally as follows: Body length 571, 518; tail 413, ——; hind foot 156, 137. Dozier (in correspondence) reports that the heaviest animal he examined at the Fur Animal Experiment Station in Cambridge, Md., weighed 21 pounds.

No skulls of this species are available from Maryland for measurement.

Habitat and habits.—The habitat of the nutria in its South American home is in marshes, swamps, and along the margins of rivers and lakes in fresh-water plant associations. Bednarik (1958, p. 2) says, however, that Randall Rhodes, Curator of Collections at the Cleveland Museum of Natural History, has told him (in personal communication 1954) that in South America he observed that nutria were mostly associated with marine waters. The temperature of the water seems to be of little importance to them, and in the United States they are now found as far north as Michigan and Washington State, where they prosper in the same type of habitat as the muskrat.

The nutria is a vegetarian, consuming a variety of aquatic plants, rushes, reeds, grasses, seeds, cattails, and sedges. In captivity it shows a marked preference for alfalfa and clover and is fond of practically all root crops except Irish potatoes. Because of its voracious appetite it has posed a serious threat to waterfowl marshes in some areas where it has been introduced.

Nutria living in streams or ponds which have steep banks burrow into them close to the water level. Each pair makes its own burrow, which is dug in and upward until well above the water level. The den is lined with grasses, and as the family grows, the burrow is enlarged.

If the nutria are living in a marsh which does not have steep banks, floating nests of aquatic vegetation are built, which resemble those made by the muskrat. Where conditions permit, part of a colony may live in floating nests in the marsh, while other animals will build bank burrows.

The gestation period of this species in Maryland is between 130 and 134 days (Dozier, unpublished data, U.S. Fish and Wildlife Service). The young seem to be born during all seasons, and there are probably two or three litters a year per female. In Louisiana, litter size averages 4.4 young (Harris, 1956).

Nutria apparently became established in the Dorchester County marshes of Maryland sometime in the early 1940's. There are no records of their occurrence there earlier, and Herbert L. Dozier, formerly Director of the U.S. Fur Animal Field Station at the Blackwater National Wildlife Refuge, does not mention their presence in the Maryland marshes in his extensive nutria correspondence in the files of the Fish and Wildlife Service dating back to the period 13 March 1939, to 3 June 1941. It is possible that Maryland's nutria population may have originated as escapees from the U.S. Fur Animal Field Station, although there is no certain proof of this. In the late 1930's and early 1940's Dozier was conducting experiments at the Blackwater Refuge on the feeding, care, and breeding of captive nutria. In one of his let-

ters dated 18 November 1940, now in the files of the U.S. Fish and Wildlife Service, he says:

> We have recently completed two new large 100 sq. ft. inclosures in marsh and pond edge and have released a pair of nutria in each to study their reactions to various types of local habitat, etc.

There is no record of what became of the inclosures or animals, and Dozier never published, to my knowledge, the results of his study.

Maryland kept no accurate records of its annual fur catch until 1949. Prior to that, only rough estimates were made each year as to the number of animals trapped in the State, and no mention was ever made of nutria. In 1949, when trappers were first required to report their catches, four nutria were among the animals taken. No further nutria were reported until 1956, when two were trapped in the Dorchester marshes. The following year the catch was 45 and in 1958 the number had risen to 52. Since then the number reported has declined. Thirty-four were reported for 1959, none for 1960, and five in 1961. It appears that nutria in the Maryland marshes are only precariously established.

Specimens examined.—Dorchester County: Blackwater National Wildlife Refuge, 8.

Family MURIDAE (Old World rats and mice)

BLACK RAT

Rattus rattus (Linnaeus)

[*Mus*] *rattus* Linnaeus, Syst. nat., ed. 10, 1: 61, 1758.

Type locality.—Uppsala, Sweden.

General distribution.—This is an introduced species. In the United States, it is well established and abundant in the south Atlantic and Gulf Coast ports. In the northeastern United States it is found in buildings along the docks of some seaports, and at several isolated inland localities.

Distribution in Maryland.—May occur at present in some buildings along the docks in Baltimore City.

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; size medium; general build slender; muzzle sharp; ears large, almost naked, reaching or covering the eyes when laid forward; tail slender and long, at least as long as the combined length of the head and body, and sometimes longer; pelage soft, but covered with coarse guard hairs, giving it a harsh appearance.

There are three color phases of this species. Some authorities have considered these as distinct subspecies because of their general association with distinct geographic areas. One of these color phases, known as *R. r. frugivorous*, has a yellowish or reddish brown dorsum, with a white or yellowish abdomen, and is most commonly encountered in the Mediterranean area. Another color variation, *R. r. alexandrinus*, has a

brownish dorsum, similar to that of *frugivorous*, but with a gray venter, and is most abundant in the Middle East and North Africa. The third color phase, known as *R. r. rattus*, has a black dorsum, with a dark gray venter, as in *alexandrinus*, and is mostly associated with the cold temperate countries of northern Europe. In general, *R. r. frugivorous* is a wild-living animal, whereas *alexandrinus* and *rattus* are nearly always associated with man and his habitations. None of these varieties, however, is exclusively limited to any of the geographic or habitational areas mentioned above, and all three forms may occur at any one locality or in any one habitat. Because of this it seems advisable at present to consider them as color phases rather than as distinct subspecies (Caslick, 1956, pp. 255–257). All of the color phases may be encountered in the United States.

Rattus rattus is most easily confused with the Norway rat (*Rattus norvegicus*). It may be distinguished from that species by its smaller size, more slender build, more elongated nose, larger longer ears, and much longer and more slender tail (as long as, or longer than, the combined length of the head and body). Cranially, the two species differ in that the braincase of *R. rattus* is shortened and rounded, whereas that of *R. norvegicus* is narrow and elongated, the well-developed temporal ridges extending parallel to each other for a considerable distance on each side of the cranium.

Measurements.—Two adults from Washington, D.C. (taken on a river boat at the Seventh Street Wharf on 23 April 1923) measure as follows: Total length 405, 423; tail 218, 238; hind foot 37, 39; greatest length of skull 43.6, 43.2; zygomatic breadth 20.8, 20.9; interorbital constriction 6.4, 6.7; length of maxillary toothrow 7.0, 6.9.

Habitat and habits.—This rat is essentially an arboreal animal and seldom inhabits burrows. Where it infests buildings and houses, it is found usually in the walls, ceilings, or roof, but seldom in basements or in sewers. It shuns water and seldom enters it voluntarily. This is, however, the common rat on ships, to which it gains access by climbing the moorings. It is occasionally introduced with shipments of grain or fruit.

In diet, the black rat is omnivorous, consuming a wide variety of grains, fruits, vegetables, and animal matter.

The species is polyestrous all the year round. The duration of gestation is about 21 days, and the average litter size is seven to nine.

Black rats enter into close relations with man wherever they occur, and for this reason they are often involved in the transmission of diseases, principally the bubonic plague.

Specimens examined.—District of Columbia: Five (three taken on river boat at Seventh Street Wharf, and two taken in the Central Market in a box of fruit from Egypt in February 1912).

Remarks.—It is generally believed that the black rat was the common rat of the eastern United States before the late 18th century. Around that time, it is said, the Norway rat was introduced, and because it is a larger and more aggressive animal it drove the black rat out except near shipping ports (see Bailey, 1923, p. 114). There is however, no real evidence that the black rat was ever well established in Maryland or in any other Northeastern State. This animal prefers a warm climate and probably found Maryland too cold for its liking. Moreover, it is known that in areas in the South the black rat and the Norway rat live in the same habitations without one species driving away the other. In areas where the two species live together, however, there seems to be an ecological separation in that the black rat usually is found in the upper stories of a building, while the Norway rat inhabits the basement and adjacent sewers and tunnels.

At the present time there are no known colonies of this species in Maryland, although perhaps a few animals inhabit some of the building along the docks in Baltimore City. In 1949 Davis and Fales (1949, p. 248) reported them present in only three Baltimore buildings and estimated the population as not more than 1,000. This rat, however, is the common ship variety and probably has been, and will continue to be, repeatedly introduced into the Baltimore wharf district.

As far as is known, none are established now in Washington, D.C., although here again they may leave boats and take up residence in nearby buildings. Five specimens have been taken in the District of Columbia. Three of these were removed from a boat that had docked at the Seventh Street Wharf in April 1923, and two were trapped in January and February of 1912 at the old Central Market, to which they apparently had been brought in baskets of fruit from Egypt.

NORWAY RAT

Rattus norvegicus (Berkenhout)

Mus norvegicus Berkenhout, Outlines of the natural history of Great Britain and Ireland, 1 : 5, 1769.

Type locality.—England.

General Distribution.—This is an introduced form that has become widely established throughout North America.

Distribution in Maryland.—Statewide.

Distinguishing characteristics.—Similar to *R. rattus*, but differs in being larger, heavier, and shorter tailed. In coloration it is grayish or reddish brown on the back, heavily lined with black hairs along the middorsal line. The belly is silvery gray, but in some specimens it may be washed with a dingy yellowish - brown. Cranial differences between this species and *Rattus rattus* are described under the latter species.

Young Norway rats superficially resemble the native American rice rats (*Oryzomys palustris*). They may always be distinguished from this species, and from other cricetines, by the upper molar teeth, which in the genus *Rattus* (and in the other introduced Murid genus *Mus*) are provided with small rounded cusps (tubercles) arranged in three longitudinal rows in contrast to two rows of longitudinal cusps in most cricetines.

Measurements.—An adult from the District of Columbia measures as follows: Total length 470; tail 208; hind foot 43; ear 21; greatest length of skull 52.6; zygomatic breadth 27.6; interorbital breadth 7.4; length of maxillary toothrow 7.3.

Habitat and habits.—This is essentially a water-loving and burrowing animal. In the spring of 1963, large numbers of them were inhabiting burrows in the banks bordering the Loch Raven Reservoir north of Baltimore. They would emerge from the burrows in broad daylight, dive into the reservoir, and swim considerable distances to obtain scraps of bread thrown into the water by visitors who were feeding the numerous carp which swim in the area near the dam. In Washington, D.C., the population of Norway rats has recently risen to alarming proportions. Their burrows may be seen around many of the downtown government buildings and monuments, and at dusk they come into the open and actively forage for food among the refuse and rubble left by tourists during the day.

The city of Baltimore has always had a Norway rat problem, but these animals are not as numerous as was thought at one time. In a careful study of Baltimore's rat population in 1949, Davis and Fales (1950, p. 146) estimated there were approximately 43,000 animals, with a range of from 26,000 to 68,000, of which about 15,000 were in commercial areas. They had estimated that the population in 1947 was 165,000, so that there was a considerable decline in the period 1947 to 1949. With improved sanitation and methods of extermination developed during the intervening years it may be assumed that the rat population of the city at present is no higher, and probably lower, than in 1949. Nevertheless, rats are still a serious economic and public health problem in Washington and Baltimore.

The Norway rat is known to occur throughout the State both in commercial buildings and habitations, and in some places in the wild, particularly in the summer.

The species is extremely adaptable, and about the only factor essential for its success is the presence of water; it drinks freely, and is a good swimmer and diver. It will eat virtually anything, and finds sewers particularly attractive places to live because of the abundant water supply and the offal usually found therein upon which it can

feed. From the sewers it will readily pass into buildings where it may cause considerable damage.

The species is an efficient burrower, and out-of-doors its bank burrows consist of winding galleries furnished with several escape holes. On farms, it frequently makes burrows in manure piles, rubbish mounds, wheat stacks, and hay ricks. Many Norway rats spend the summer months in fields and meadows, and at the approach of cold weather migrate into towns and villages where they seek the warmth of commercial buildings and other habitations.

The gestation period in the Norway rat is 21 days. Studies in England (Hinton, 1931, p. 13) indicate that the average number of young per litter is eight or nine, but that there are records of as many as 23. Usually the number ranges between 6 and 19, and the females may produce five or six litters annually.

It is generally believed that the Norway rat and the black rat are incompatible, and that the larger, more aggressive Norway rat will drive out or kill the smaller, weaker black species wherever they are occupying the same area. There is no proof of this, however, and there are even cases known where the two species have lived together in the confines of a small ship (John Jones, U.S. Fish and Wildlife Service, in verbis). The fact that they only infrequently occur together is probably the result of their preference for different climatic situations. The Norway rat is essentially a northern, cool climate animal and prospers in the temperate regions of northern Europe and North America. The black rat originated in warm, semitropical areas and find its optimum conditions in the warm Mediterranean regions and in the southern portions of the United States. It seems probable that the black rat, although repeatedly introduced, has never been firmly established in the northeastern United States and that the Norway rat has been the common house rat in Maryland since early colonial times.

Specimens examined.—Anne Arundel County: Fort Meade, 1. *Baltimore City:* 1. *Calvert County:* Solomons Island, 1. *Montgomery County:* Silver Spring, 1 mile N, 3. *District of Columbia:* 77.

HOUSE MOUSE

Mus musculus Linnaeus

Mus musculus Linnaeus, Syst. nat., ed. 10, Vol. 1, p. 62, 1758.

Type locality.—Uppsala, Sweden.

General distribution.—This is an old world species that has been introduced into the United States and is now found in a commensal and feral state throughout the country.

Distribution in Maryland.—Occurs abundantly as a commensal or as a feral animal in all sections of the State.

Distinguishing characteristics.—This small mouse is well known and needs no extensive description. The upper molar teeth of the house mouse are essentially like those in *Rattus rattus* and R. *norvegicus*, that is, with three rows of longitudinally arranged cusps. This distinguishes the species from all other Maryland mice of small size.

Externally, the house mouse superficially resembles American mice of the genera *Peromyscus* and *Reithrodontomys*. It differs from Maryland *Peromyscus* externally in its smaller size and in coloration. In adult pelage, *Peromyscus* is generally a brownish gray in coloration on the dorsum, with a white venter, the line of demarcation between the two being sharply marked. The tail also is distinctly bicolored, darker above, pale below. In the house mouse, the coloration is more grayish and the abdomen is generally paler than the dorsum, but there is no sharp line of demarcation between the two, the abdomen seldom being pure white as in *Peromyscus*. In addition, the tail of the house mouse is not distinctly bicolored.

The dorsum of the juvenile *Peromyscus* is colored a uniform slaty gray, which is totally unlike the grizzled gray of the house mouse, and the venter is a snowy white as in adults, with a sharp line of demarcation between the two.

Externally, the house mouse is very smiliar in appearance to the harvest mouse (*Reithrodontomys humulis*). The most certain way of separating the two species is through an examination of the upper incisor teeth. In *Reithrodontomys* there is a longitudinal groove which runs the length of each incisor, while in the house mouse these teeth are smooth. In addition, the biting edges of the upper incisor teeth of the house mouse usually are notched, and the tips of the lower incisors fit into the notches when the jaws are closed.

Measurements.—Seven adults from the vicinity of Ocean City, Worcester County, have the following external measurements: Total length 149.3 (140–167); tail vertebrae 73 (58–88); hind foot 17.4 (16–18). Cranial measurements of five adults from the vicinity of Ocean City are: Greatest length 20.9 (19.8–21.8); zygomatic breadth 11.0 (10.6–11.5); interorbital breadth 3.4 (3.3–3.6); length of maxillary toothrow 3.2 (3.1–3.4).

Habitat and habits.—This is a very plastic animal, and it has adapted itself to a wide variety of habitats. Like the black rat and the Norway rat, it is most often encountered in or near human habitations, but is also found in the wild throughout Maryland.

This species probably is of Asiatic origin. It is efficient at climbing, jumping, and swimming; and it will eat and thrive on practically any food that man consumes. Its nest is made of soft materials and is placed in any convenient location, such as in walls, under floors and steps, in bookcases or furniture, and, in the wild, under logs or stones and other convenient recesses.

The house mouse is very prolific. It attains sexual maturity at the age of 3 months and the breeding season is of long duration. The gestation period is from 19 to 21 days, and the number of young per litter is usually five or six. The young are born blind and naked, but they mature rapidly and are able to leave the mother in about 3 weeks.

When these mice inhabit houses in large numbers, they do considerable damage by eating large quantities of food, or tainting it with their droppings. They will consume linen clothing of all types, gnaw on books, and chew holes in the woodwork. In shops, warehouses, granaries, and on farms, they are usually abundant and destructive.

In Maryland, the house mouse is found everywhere, even on marshes and dunes of the Atlantic outer barrier beaches.

Specimens examined.—Allegany County: Green Ridge, 1; Mount Savage, 7. *Anne Arundel County:* Annapolis, 3 miles NW, 1. *Calvert County:* Drum Point, 1; Plum Point, 2; Plum Point, 2 miles W, 6; Scientists Cliffs, 2; Solomons Island, ¾ mile N, 11. *Charles County:* Nanjemoy Creek, 1; Port Tobacco, 4. *Howard County:* Long Corner, 2. *Montgomery County:* Cabin John Bridge, 2; Chevy Chase, 3; Forest Glen, 5; Gaithersburg, 5 miles NE, 1; Kensington, 7; Seneca Creek, 1; Silver Spring, 1 mile N, 2. *Prince Georges County:* Beltsville, near, 1; College Park, 1; Lanham, 1; Laurel, 5; Mitchellville, 1 mile W, 9; Oxon Hill, 6; River View, 1; sphagnum bog, near District line, 1. *Queen Annes County:* Parson Island, 1. *Washington County:* Fort Frederick State Park, 2. *Worcester County:* Ocean City, 3; Ocean City, 5 miles S, on Assateague Island, 3; West Ocean City, 4. *District of Columbia:* 83.

Remarks.—Schwarz and Schwarz (1943, pp. 59–72) reviewed the species and suggest that all house mice in the United States are referable to two commensal subspecies *M. m. brevirostris* and *M. m. domesticus*, the latter being the one that supposedly occurs in Maryland. In all probability, however, house mice have been introduced into Maryland from many different areas and at many different times. The range of variation in size, tail length, and coloration in Maryland specimens is so great that I am unable to assign them a subspecific name.

336–897 O—69——9

Family ZAPODIDAE (jumping mice)

MEADOW JUMPING MOUSE

Zapus hudsonius americanus (Barton)

Dipus americanus Barton, Trans. Amer. Philos. Soc., 4: 115, 1799.

Type locality.—Schuylkill River, a few miles from Philadelphia, Pa.

General distribution.—Southeastern United States, east of central Indiana, and south of central New York, southward into northern Georgia.

Distribution in Maryland.—Occurs in all sections of the State.

Distinguishing characteristics.—Teeth 1/1, 0/0, 1/0, 3/3, = 18; upper incisors grooved; tail very long, blackish above, white below (not white tipped); hind legs greatly elongated; pelage short and coarse; coloration yellowish orange, suffused with blackish, the blackish particularly concentrated in the middorsal area and generally forming a rather broad band from nose to tail; coloration of underparts white, sometimes suffused with yellowish orange.

This mouse is readily distinguished from all other Maryland mice, except the woodland jumping mouse (*Napaeozapus insignis*), by its very long tail and powerful elongated hind legs. It is distinguishable from *Napaeozapus* by the presence of a premolar in the upper jaw, the absence of a white tail tip, and the more yellowish coloration (as opposed to orange in *Napaeozapus*) on the flanks.

Measurements.—Measurements of three adults from the vicinity of Seneca, Montgomery County, are as follows: Total length 195, 194, 194; tail 120, 110, 110; hind foot 26, 28, 28; ear 11, 10, 10; greatest length of skull 21.6, 22.0, 22.7; zygomatic breadth 10.5, 10.9, 10.6; interorbital breadth 4.2, 3.9, 4.0; length of maxillary toothrow 3.6, 3.7, 3.5.

Habitat and habits.—Krutzsch (1954, pp. 349–472) revised this genus, and gathered together its natural history data. Most of the following is based on his account.

The meadow jumping mouse inhabits thick vegetation, usually grasses or forbs, or both, in areas near running water. It is found both in woodland and farmland, but is most abundant in open moist areas. In Maryland, the species occurs throughout the State in suitable habitat, although nowhere does it seem particularly abundant, except perhaps on Assateague Island, where it is common in the mixed cordgrass and myrtle back of the ocean dunes.

The species is cyclical in abundance, being more numerous in some years than in others. It is ordinarily a nocturnal animal, appearing in the early dusk and remaining active until predawn. Occasionally, individuals will be active during daylight hours. Meadow jumping mice hibernate in the winter. It appears that it is necessary for this

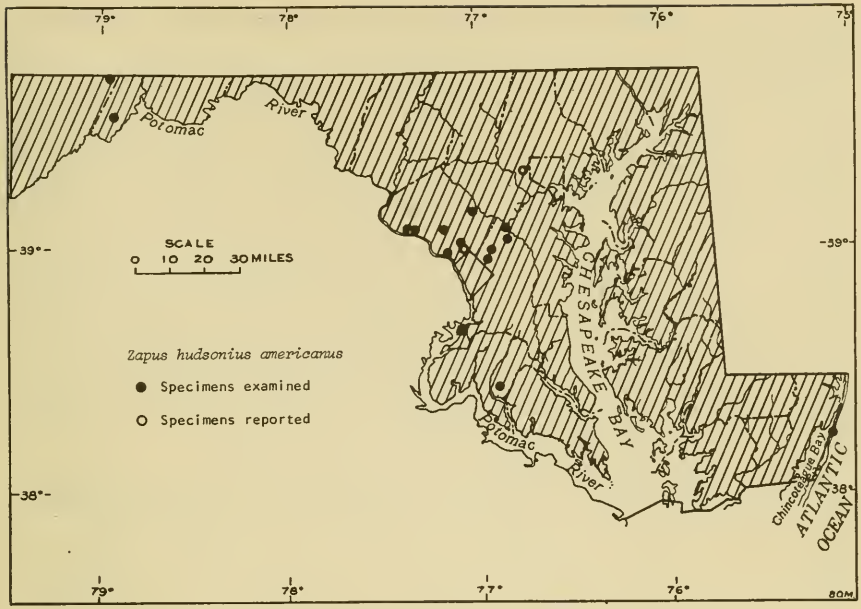

FIGURE 42.—Distribution of *Zapus hudsonius americanus.*

mouse to accumulate a certain amount of fat before it is capable of hibernation (Hamilton 1935, p. 193), and thus those taken in autumn are usually fat.

Almost invariably, meadow jumping mice hibernate in burrows in which nests are constructed of grass, leaves, or other vegetation. Grizzel (1949, pp. 74–75) found two of these animals hibernating in woodchuck dens at the Patuxent Research Center in January 1948. One animal was found 4 feet from the entrance to the burrow and about 40 inches below the surface of the ground. The second was found in another burrow 5 feet from the entrance and 26 inches below the surface. Both animals were curled up in the center of large leaf nests and well insulated from the cold.

In the vicinity of Washington, D.C., these mice remain active well into November, and emerge from hibernation in early April. In the Allegheny Mountain section, and the Ridge and Valley section, the hibernation period is more prolonged. Occasionally, during mild spells in midwinter they merge from their burrows and become active. Barbehenn tells me that he collected one jumping mouse in an old orchard with honeysuckle and poison-ivy ground cover near Rockville, Montgomery County, on 11 February 1960, in very mild weather.

During their active part of the year, meadow jumping mice wander freely and seldom make well-defined trails or runways. They con-

struct nests of grass and leaves under logs or occasionally in a clump of shrubs a few inches above the ground.

Krutzsch (1954, p. 428), citing various investigators, lists the following foods consumed by these mice: Insects, berries, seeds, nuts, fruits of various kinds, and roots. It has been noted that meadow jumping mice are highly insectivorous (Quimby, 1951, pp. 85–86).

According to Krutzsch (1954, p. 429), meadow jumping mice commence to breed shortly after they come out of hibernation, and the breeding season is prolonged until just before they reenter hibernation in the autumn. There are probably two litters produced each breeding season, and the number of young per litter varies from three to eight. Bailey (1923, p. 120) reported a specimen from Sandy Springs, Montgomery County, taken on 19 May 1906, that contained six large embryos. The gestation period is approximately 18 days.

Specimens examined.—Allegany County: Dans Mountain, 1. *Charles County:* Marshall Hall, 1; Newport, 2. *Garrett County:* Cunningham Swamp, 4; Finzel, 1. *Montgomery County:* Cabin John Bridge, 2; Kensington, 1; Rockville, 2 miles W, 1; Sandy Springs, 2; Seneca 1/8 mile N, 1; Seneca, 3 miles W, 2. *Prince Georges County:* Branchville, 1; Laurel, 8; Patuxent Research Center, 2; Tuxedo, 1. *Worcester County:* Ocean City, 5 miles S (Assateague Island), 1. *District of Columbia:* 7.

Other records and reports.—Baltimore County: Patapsco State Park (Hampe, 1939, p. 7). *Montgomery County:* Forest Glen (one seen by G. S. Miller and reported by Bailey, 1896, p. 98). *Prince Georges County:* College Park (Krutzsch, 1954, p. 439).

Remarks.—According to Krutzsch (1954, p. 439), specimens from Maryland, Virginia, and North Carolina are more nearly average representatives of the subspecies *americanus* than are those from the region of the type locality.

WOODLAND JUMPING MOUSE

Napaeozapus insignis insignis (Miller)

Zapus insignis Miller, Amer. Nat., 25: 742, August 1891.

Type locality.—Restigouch River, New Brunswick, Canada.

General distribution.—Eastern Canada, from Nova Scotia, New Brunswick, and Quebec south of St. Lawrence River, south into northeastern Ohio, northern West Virginia, and western Maryland.

Distribution in Maryland.—Allegheny Mountain section; may also occur in the Ridge and Valley section, but has not been reported from there as yet.

Distinguishing characteristics.—Teeth 1/1, 0/0, 0/0, 3/3, = 16; closely resembles the preceding species, but somewhat larger in size; coloration

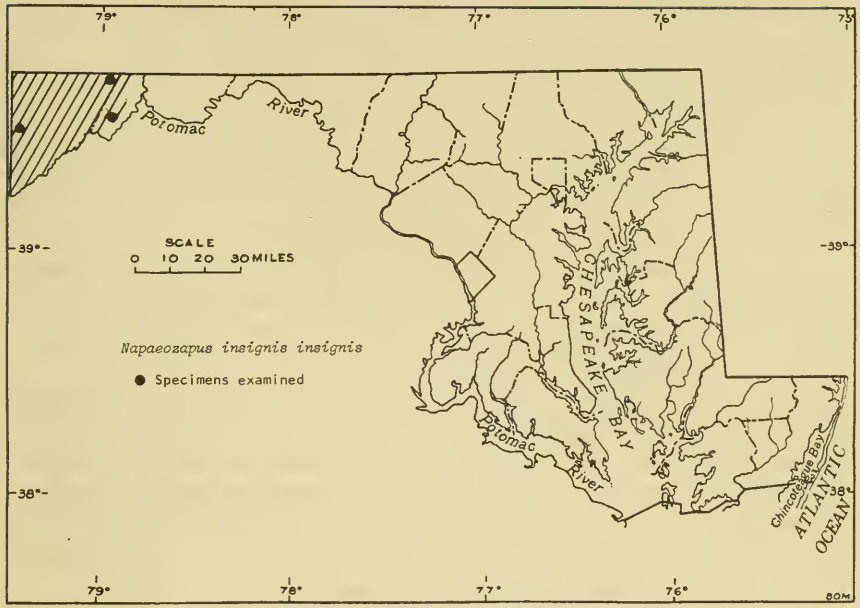

FIGURE 43.—Distribution of *Napaeozapus insignis insignis.*

similar to that of *Zapus,* but with a more brilliant orange on flanks tail grayish above, white below, with a distinct whitish tip; upper incisors grooved as in *Zapus;* only 3 molars present in maxillary, as opposed to 3 molar and 1 premolar in *Zapus.*

Measurements.—Measurements of six adults (Coll. U. Mich.) from 5 miles SE of Grantsville (alt. 2,500 ft.), Savage River State Forest, Garrett County, are as follows: Total length 223 (215–230); tail 134.7 (130–138); hind foot 30 (29–31); ear 16.2 (16–17); greatest length of skull 23.1 (22.2–23.7); zygomatic breadth 12.1 (11.8–12.3); interorbital breadth 4.5 (4.1–4.7); length of maxillary toothrow 3.6 (3.4–3.8).

Habitat and habits.—This species prefers the moist, cool forests where it is particularly abundant along the banks of mountain streams. One of the Maryland specimens was taken along Muddy Creek, near Swallow Falls, in a Rhododendron and hemlock forest which is typical woodland jumping mouse habitat. Handley and Patton (1947, p. 184) found that in Virginia they are most common at high altitudes among ferns, blackberry, and St.-Johns-wort in clearings surrounded by forest. The woodland jumping mouse is seldom found in open meadows, fields, or marshes where this is no heavy forest within close proximity.

This species makes no well-defined trails or runways, but utilizes the burrows of moles and larger shrews, or seeks shelter under rotting logs and fallen trees. Nests are usually placed several inches below

the ground and are made of leaves and dry grass. Sometimes the entrance to the nest is closed when the animal is in the burrow.

During the colder months of the year, woodland jumping mice hibernate, and their life processes are reduced to a mininum. In the autumn they eat heavily and accumulate large stores of fat on the body to carry them over the long period of hibernation. Their hibernation, deep and prolonged, is usually half of the year.

Hamilton (1941, pp. 260–261) lists the food of the woodland jumping mouse as insect larvae (particularly lepidopterous and dipterous forms), spiders, small soil worms, centipedes, various small invertebrates, small seeds, tiny nuts, small green leaves, blueberries, raspberries, and fragments of *Asplenium* fronds.

This species normally raises but one litter a year. The gestation period is between 20 and 23 days, and from two to six young, possibly eight, comprise a litter; the most frequent number appears to be five.

Specimens examined.—Allegany County: Dans Mountain, 2. *Garrett County:* Finzel, 1; Grantsville, 5 miles SE (Savage River State Forest), 8 (Coll. U. Mich.); Muddy Greek Falls, 3 (Coll. U. Md.); Swallow Falls State Forest (along Muddy Creek), 1.

Remarks.—Although Preble (1899, p. 35) noted that the specimen he collected at Finzel showed no approach to *N. i. roanensis* (type locality: Roan Mountain, N.C.), it is my opinion that this specimen and one from Swallow Falls State Forest and eight from 5 miles SE of Grantsville show traits that are characteristic of *roanensis*. They are smaller in size and darker in coloration than typical *insignis*, and they appear to represent intergrades with *roanensis*. However, they are closer to *insignis* than *roanensis* in these characters and are herein assigned to the former subspecies.

Order CARNIVORA (flesh-eating mammals)

Family Canidae (dogs, foxes, etc.)

COYOTE

Canis latrans Say

Canis latrans Say, in Long, Account of an exped. . . . to the Rocky Mts. . . . , 1: 168, 1823).

Type locality.—Engineer Cantonment, about 12 miles southeast of the present town of Blair, Washington County, Nebr., on the west bank of the Missouri River.

General distribution.—Distributed primarily west of Mississippi River, from Alaska to Central America, with the center of population in the Great Plains of the United States. The species has recently been reported from a number of Eastern States, and apparently has been expanding its range eastward. Some of the eastern populations, however, may be derived from animals that escape from captivity, particularly those populations in Southern States.

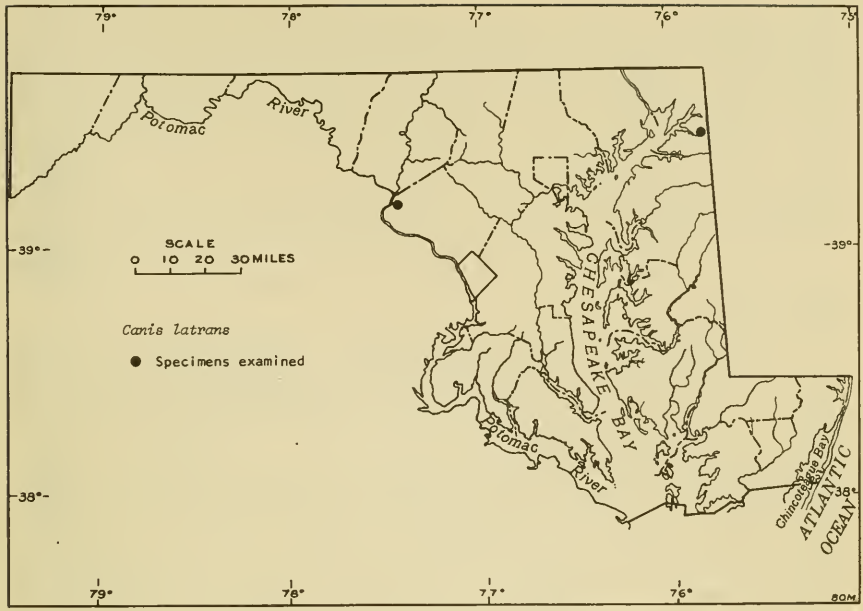

FIGURE 44.—Distribution of *Canis latrans*.

Distribution in Maryland.—May be expected anywhere in the State. See discussion in Remarks section.

Distinguishing characteristics.—Teeth 3/3, 1/1, 4/4, 2/3, = 42; closely resembles a small police dog, but with shorter legs, a bushier tail, and a more slender muzzle. Some feral dogs are so similar to coyotes that it is a difficult task for even an expert to distinguish them. The problem is further compounded because the coyote and dog may interbreed in the wild, although authentic reports of such crosses are scarce. There does not appear to be any certain way to distinguish coyote-dog hybrids from pure domestic dogs.

The coyote is grayish in coloration, and the dorsal hairs are tipped with black. There is a rusty or yellowish tint on the neck and along the sides, particularly on the flanks. The head is grizzled gray; the ears brownish. The feet are fulvous, and the throat and belly white. Since some domestic dogs may be similar to this in coloration, it is sometimes necessary to examine the skull to determine the species of the animal in question. The most important cranial difference between the two is that in the coyote the frontal region of the skull is always flattened, whereas in the dog it bulges to some degree. In some varieties of domestic dog this bulge is quite pronounced, in others it is less so, but it is generally more developed than in the coyote. The second most noticeable difference is found in the rostrum, which is slender and elongated

in the coyote and usually shorter and more blunt in the dog. In addition, the tips of the upper canines of the coyote fall below the level of the anterior mental foramina when the jaws are closed; in the dog they terminate above these foramina. The premolar teeth in the coyote are generally widely space; in the dog they are crowded. The ventral surface of the mandibular ramus is flattened in the coyote, whereas in the dog it is generally rounded. Various indexes have been developed to express numerically some of the above-mentioned cranial differences (see Howard, 1949, p. 171; Bee and Hall, 1951, pp. 73–77; Burt, 1946, pp. 61–62).

Certain specimens exhibit a confusing combination of dog and coyote characteristics. These animals may represent hybrids, but the characteristics of known hybrids have not been adequately documented. Until the problem of hybridization between the coyote and dog is thoroughly studied it seems advisable to refer any questionable specimens to the latter species. The domestic dog is one of the most variable animals with regard to its physical structure, whereas the coyote is a very uniform one (except for size). Because of this, it is possible for the domestic dog to exhibit some coyote traits without having any admixture of coyote blood, whereas it is far less likely that a coyote would exhibit dog traits without some dog intermixture.

In the field, the coyote at a distance may resemble a gray wolf (*Canis lupus*). The coyote, however, is much the smaller animal, has a more yellowish cast to the pelage, and carries its tail lower when running. The skull of the coyote is smaller than that of the gray wolf, and more lightly built; the teeth are much smaller, and the frontal region of the skull is flat, whereas in the gray wolf it is bulging as in the domestic dog.

Both the red fox and the gray fox are less doglike in general appearance than the coyote, and both are considerably smaller in size, and different in coloration.

Measurements.—Externally the coyote ranges in total length from 1,052 to 1,320 mm. with a tail varying from 300 to 394 mm. The hind foot averages between 177 and 220 mm. (Hall and Kelson, 1959, p. 843). Animals from southwestern localities are smaller than those from farther north, and males are larger than females.

A male from 5 miles northwest of Poolesville, Montgomery County, and a female from Cecil County, near the Delaware State line, west of Middlebury, Del., have the following cranial measurements: Condylobasal length 180.4, ——; zygomatic breadth 99.8, 87.8; interorbital breadth 29.6, 31.5; length of maxillary toothrow 82.3, 78.7.

Habitat and habits.—The coyote prefers open or semiopen country. Young (Young and Jackson, 1951, p. 11) calls the coyote an "edge" animal, and believes that it has expanded its range as the forested

areas of the country vanished either through natural means such as forest fires or through manmade means such as logging etc. With the clearing of the land in the Northeastern United States, the coyote probably found habitat there to its liking, and has extended its range eastward.

The habits of the coyote are thoroughly discussed by Young and Jackson (pp. 47–105). The following is compiled primarily from their findings.

The home of the coyote is usually a den which it constructs on a bank or hillside, in wheat or corn fields, under houses, shacks, drainage pipes, or in hollow logs in thickets. Often the animal makes use of a fox or skunk den, enlarging it to suit its needs.

As a rule, coyotes do not mate for life, but some pairs may remain together for a number of years. There is evidence that the female may breed when she is 1 year of age. The breeding season is from February to March or April, being earlier apparently in northern than in southern latitudes (Hamlett, 1938). The gestation period is 60 to 63 days, and females have been known to deliver as many as 17 to 19 young, although 5 to 7 is the usual number.

Sperry (1941) examined the stomachs of 8,339 coyotes from western and midwestern localities and found that the principal food of the species is animal matter, of which more than 90% consists of mammals. In addition to carrion (25.1%), the chief mammals consumed are rabbits (33.2%), rodents (17.5%), domestic livestock (13.5%), big game mammals, principally deer (3.6%), and miscellaneous mammals such as skunks, badgers, weasels, shrews, moles, foxes, raccoons, cats, etc. (1%). Birds comprise some 2.9% of the coyote's diet, and other vertebrates 0.08%. Insects account for 1% of the diet, and vegetable matter, principally wild fruit and cultivated fruit, some 1.7%. These percentages vary according to seasonal availability.

Specimens examined.–Cecil County: Near Delaware line, west of Middletown, Delaware, 1. *Montgomery County*: Poolesville, 5 miles NW, 1.

Remarks.—The coyote has been reported from nearly all of the Eastern States. It is known that the species has been extending its range eastward. Probably the coyotes of our Northeastern States are a result of the natural expansion of the range of the species. On the other hand, coyotes have been introduced accidentally, or on purpose, into some of the Southeastern States, and present populations in those States may derive from these artificial introductions.

The first coyote discovered in Maryland was taken on 5 February 1921, on a farm 5 miles NW of Poolesville, Montgomery County. Jackson (1922, p. 187) in a discussion of this animal says:

The question naturally arises as to how a coyote reached this eastern locality. It is, of course, impossible to say definitely. The animal probably escaped from captivity. Or it may represent an extreme eastern extension of the geographic range of coyotes. There is no direct evidence for or against either of the suppositions. It is known that the range of the coyotes has gradually extended northward and eastward, but it would seem hardly probable that the species has, as yet, ingressed a region as far east as central Maryland.

The area in which this animal was taken was transversed by a major east-west arterial highway (U.S. Route 40) and it seems highly likely that the animal was brought into the area artifically. This view is supported by the fact that nearly 40 years elapsed before another coyote was discovered in Maryland. If the Montgomery County coyote really represented a southward or eastward extension of the range of the species, there probably would have been at least occasional reports of their presence in the State in later years. As it is, not until 21 April 1961 was another coyote discovered in Maryland. On this date, a coyote was shot in Cecil County near the Delaware border by employees of the Delaware Board of Game and Fish Commissioners. Here again, the area where the animal was shot is near a major east-west highway system and not very distant from the cities of Baltimore, Wilmington, and Philadelphia. It seems likely that the animal was brought east as a pet, and either was released or escaped from captivity. On the other hand, the increasing number of reports of coyotes from New England, New York, and other Northeastern States make it more probable now than it was 40 years ago that the species has reached Maryland in its natural range expansion. It is still, nevertheless, impossible to say definitely.

RED FOX

Vulpes vulpes fulva (Desmarest)

Canis fulvus Desmarest, Mammalogie . . ., pt. 1, p. 203, *in* Encyclopédie méthodique . . . 1820.

Type Locality.—Virginia.

General distribution.—Most of the Eastern United States, from southern Maine, southern Ontario and Wisconsin, south to Alabama, Georgia, and the Carolinas.

Distribution in Maryland.—Occurs in all sections of the State.

Distinguishing characteristics.—Dental formula as in *Canis;* similar in size and general characteristics to a small dog; nose sharply pointed; ears prominent and erect; tail long and bushy, fulvous, but strongly streaked with black, and always with a white tip; pelage long and soft; coloration rusty on face and occiput, usually mixed with whitish; upper parts colored bright yellowish red, or fulvous, darker on the median line, with the rump grizzled with whitish; cheeks, chin,

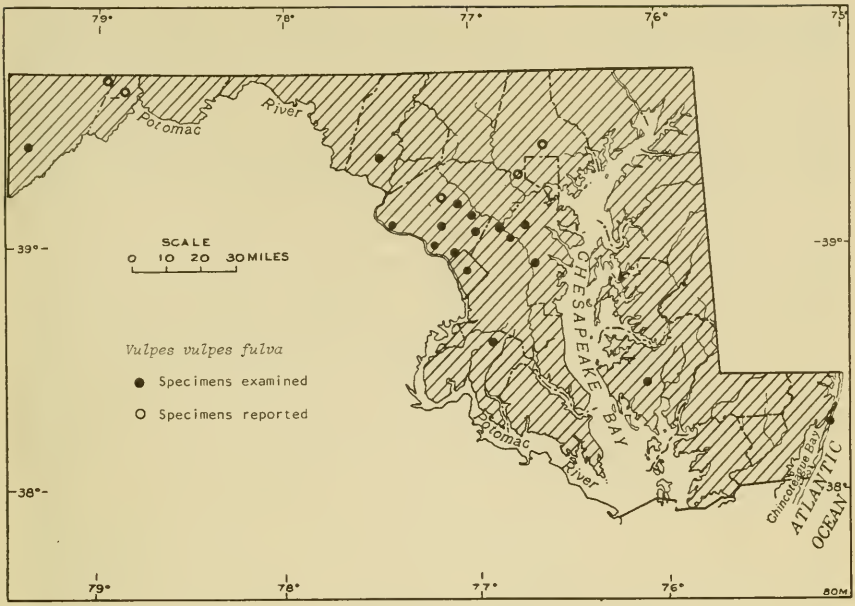

FIGURE 45.—Distribution of *Vulpes vulpes fulva*.

throat, and a band down the abdomen white; feet and outside of ears black.

Cranially, this fox differs from the gray fox (*Urocyon*) in that the temporal ridges enclose a narrow V on the top of the skull, whereas in the latter they are distinctly lyrate in shape; the upper incisors are lobed, in contrast to the unlobed condition in *Urocyon*.

Measurements.—Three adult males from Montgomery County have the following external measurements: Total length 1030, 1000, 995; tail 370, 372, 360; hind foot 170, 165, 160; ear 83, 86, 85. Cranial measurements of seven adults from Montgomery County are as follows: Basal length 139.7 (133.8–143.6); zygomatic breadth 72.0 (69.7–74.0); postorbital constriction 23.9 (22.0–28.8); alveolar length of upper maxillary toothrow 61.8 (59.5–63.4).

Females average smaller than males in size.

Habitat and habits.—The red fox is cosmopolitan in its distribution, except that it is not generally found in dense forests and woods. It prefers rolling farmland, sparsely wooded areas, brushlands, and dense weed patches, usually in the vicinity of a stream or lake.

The species is now abundant in all sections of the State, although at one time it apparently was not found here. According to Mansueti (1950, pp. 27–28), the early American settlers hunted the gray fox (*Urocyon cinereoargenteus*). The Indians were unanimous in claiming that before the coming of the Europeans there were no red foxes

in the area. Sometime around 1650, red foxes were imported from England and released along the Eastern Shore of Maryland. These foxes apparently thrived and by the late 1670's had spread down the peninsula into Virginia. Today the species is widely distributed in Maryland, and is found even within the limits of metropolitan areas such as Baltimore and Washington, D.C. Whether the fox which now occurs throughout the State is the variety introduced by the English, or the native eastern North American form which has extended its range southward, will be discussed under the Remarks section.

The red fox is extremely abundant in some areas of the State. According to the League of Maryland Sportsmen (Rally Sheet 4(10), p. 6, December 1946) 79 were caught in a 5-week period at Mount Savage, Garrett County, in 1946. At the eastern end of the State on the outer barrier beach of Assateague Island, it is also abundant, and does some damage to nesting birds and their eggs. This species still roams in Rock Creek Park in the heart of Washington, D.C.

The food of the red fox varies from season to season. Llewellyn and Uhler, (1952, p. 198) found that in their Maryland sample, comprising mostly November, December, and January animals, 17 percent of the food was plant material consisting of fruits, berries, and other plant items. Persimmon, pokeberry, and wild grape were most often consumed, while in the fall beechnuts were heavily utilized. Apple, pear, and corn were eaten to a minor extent. The bulk of the red fox's food consists of animal foods, the most important part of which appears to be rabbit. Also consumed are rodents (meadow mice, muskrats, pine mice, gray and flying squirrels, house mice) and shrews. Birds and occasionally insects are eaten. In the spring and summer months the food consists of woodchucks, poultry, rabbits, small rodents, birds, snakes, turtles, eggs and varying amounts of vegetable matter particularly raspberries and blackberries. There is no question that red foxes prey to some extent on domestic livestock, particularly poultry when it is not properly housed. Sometimes red foxes may become quite bold. Vernon Bailey (unpublished report in files of U.S. Fish and Wildlife Service, 25 April 1936) tells of a pair raiding the henhouse of a farm in Brookville, Montgomery County; they were so bold that they often raided in broad daylight and took the hens before the eyes of their owners.

The red fox is monogamous and is believed to remain mated for life. The species is monestrous, with one season a year. Most matings take place in late January or February, and the gestation period is between 49 and 55 days. Litter size varies between one and eight, with four or five being the usual number.

The breeding or family den of the red fox is nearly always in a burrow, often that of a woodchuck, and is more often located in more

open land, such as a pasture, fence border, or cultivated field. Vernon Bailey (unpublished report, 1936) described one such den at Brookeville as follows:

> The den had four openings, or doorways, 10, 15, and 20 feet apart, really the old doorways of a woodchuck den enlarged to fox size. Two opened out on each side of a big chestnut log, 3 or 4 feet in diameter. The burrows had been dug out by the foxes to about twice the diameter of the woodchuck burrows and enlarged to a comfortable fox nest room 20 feet back from the main entrance and 10 feet back from the other doorways. They ran 3 or 4 feet below the surface through hard clay full of rocks that necessitated many crooks and turns but ran uphill so the nest chamber was actually higher up than the actual doorway. All of the burrows centered at the nest, beyond which the original woodchuck burrow extended about 10 feet further but did not come to the surface.
>
> There was no nest material in the nest chamber, but semidry earth made a comfortable bed for the young foxes with their dense woolly coats, and a uniform temperature that I should guess was around 55° F. gave them a healthy home in the den.

Both parents hunt for food to provide for the young. Bailey describes the food found in the den at Brookeville:

> Much food had been brought into the den by the parent foxes. One white rooster had been all eaten but the wings and head and telltale feathers scattered around the doorway; one large house rat was lying near the doorway and two others were found in the nest chamber and parts of four others in the pantry, an excavation half full of food at one side of the upper entrance. It was about four feet below the surface and so cool that all of the meat was fresh though some of it several days old. From this were taken out part of a cottontail, half a crow, and a mouse.

Specimens examined.—Anne Arundel County: Fort George G. Meade, 1; Priest Bridge (near), 1. *Charles County:* Waldorf, 1. *Dorchester County:* Blackwater National Wildlife Refuge, 9. *Frederick County:* Jefferson, 2. *Garrett County:* Oakland, 1. *Howard County:* no exact locality, 1. *Montgomery County:* Bethesda, 1; Brookeville, 1; Fairland, 1; Poolesville, 5 miles SW, 3; Potomac, 1; Rockville, 1; Sandy Spring, 1; no exact locality, 1. *Prince Georges County:* Laurel, 5; Patuxent Research Center, 4. *Worcester County:* Ocean City, 3 miles S (Assateague Island), 2. *District of Columbia:* 3.

Other records and reports.—Allegany County: Mount Savage (League of Maryland Sportsmen, Rally Sheet 4(10), p. 6, December 1946). *Baltimore County:* Loch Raven (Kolb, 1938); Patapsco State Park (Hampe, 1939, p. 6). *Garrett County:* Finzel (E. A. Preble in field report). *Montgomery County:* Laytonsville (rabid red fox reported in Washington Evening Star, 28 December 1956); Plummers Island (Goldman and Jackson, 1939, p. 132).

Remarks.—It is well established that the red fox was either scarce or did not occur in Maryland prior to the colonization of the State by Europeans. Churcher (1959, p. 514) states that "a red fox was native

to North American north of Lat. 40° N or 45° N, but was either scarce or absent from most of the unbroken mixed hardwood forests (to the south of this) where the gray fox was paramount."

The early Maryland colonists originally hunted the gray fox, but apparently at a very early date the European red fox was imported for hunting purposes and was released at various localities, one of which was the Eastern Shore. Since the red fox is now found throughout the whole of Maryland, as well as much of the Southeastern United States, the question arises whether these southern red foxes are the European variety or native North American red foxes which have extended their range southward.

Churcher (1959, pp. 513–520) has established that the European red fox and the North American red fox are subspecies of the same species *Vulpes vulpes*, the various subspecies intergrading in several major characters (shape of upper first molar, breadth of rostrum, development of sagittal crest) from western Europe, through Siberia, Alaska, Canada, to eastern North America. The two end products, the western European red fox and the eastern North American red fox are, however, quite different animals even if only subspecifically distinct. The European red fox is larger and has a more robust skull than its eastern American relative. It also has a shorter, broader rostrum, a relatively narrower interorbital region, and a well-developed sagittal crest which forms a distinct ridge along the top of the skull. In the native eastern American red fox the sagittal crest is occasionally developed but usually not into a conspicuous ridge. It narrowly diverges anteriorly into the temporal ridges which enclose a conspicuous V on the top of the skull. This conspicuous V formed by the temporal ridges is usually not as well developed, or is lacking, in the European form. The shape of the first upper molar also differs in the two subspecies. In the European variety this tooth is large and square in general outline, the buccal cingulum is rounded, the talon broad, and the mesial face convex. In the American form, the tooth gives the general appearance of being elongated laterally; the buccal face is deeply indented, the talon elongated, the mesial and distal faces concave, and there is a small protoconule.

All the Maryland red foxes (and those from farther south) that I have examined show the characters of the native eastern North American form, and there seems to be no indication of intermixture with European fox blood. In fact, Maryland specimens appear to be indistinguishable from those of Wisconsin, Michigan, southern Ontario, and New England, where I presume there was little or no importation of European stock by early colonists. It is possible that with the clearing of land in the Southeastern United States, the habitat became well suited to the native American red fox, which then invaded the area

from the north. The European red foxes, which may never really have been well established in the United States, were perhaps swamped by the influx of native American foxes and left no recognizable characteristics on the present fox population in Maryland or elsewhere in the Southeast.

GRAY FOX

Urocyon cinereoargenteus cinereoargenteus (Schreber)

Canis cinereo argenteus Schreber, Die Saugtheire . . ., Thiel 2, Heft 13, pl. 92, 1775.

Type locality.—Eastern North America.

General distribution.—Distributed from southern New York and Lower Peninsula of Michigan, south to South Carolina and Tennessee, west to eastern Illinois.

Distribution in Maryland.—Occurs in all sections of the State. It is more abundant, however, in the rolling hilly country of the Piedmont, Ridge and Valley, and Allegheny Mountain sections than in the low, flat, mashy country of the Eastern Shore section.

Distinguishing characteristics.—Dental formula as in *Canis;* coloration grizzled gray above with hairs banded with black and grayish white; inner sides of legs, sides of belly, neck, and band across chest reddish brown; belly and throat white; chin black; underfur soft and wooly, overlaid with short, coarse guard hairs; tail bushy, laterally compressed with a concealed mane of stiff black hairs on its upper side, near the base; legs short, feet equipped with well-curved claws that adapt the animal for climbing; skull with temporal ridges whose divergent branches enclose a lyrate area and never coalesce to form a distinct, sharp central sagittal crest.

This fox is somewhat smaller in size, has shorter legs, and is differently colored, than the red fox.

Measurements.—An adult male from Washington, D.C., has external measurements as follows: Total length 996; tail 356; hind foot 143; ear 71. The animal weighed 10½ lbs.

Six adults of both sexes from Laurel, Prince Georges County, have the following cranial measurements: Basal length 112.7 (110.8–114.0); zygomatic breadth 67.0 (63.0–70.8); interorbital breadth 24.9 (23.8–27.3); alveolar length of maxillary toothrow 51.6 (50.9–52.9).

There does not appear to be any appreciable size difference between the sexes.

Habitat and habits.—This animal is essentially a southern and western species that has apparently only recently invaded this northern portion of its range (Hamilton 1943, p. 176). It prefers timbered and rocky regions. Because of its relatively short legs, it has no great

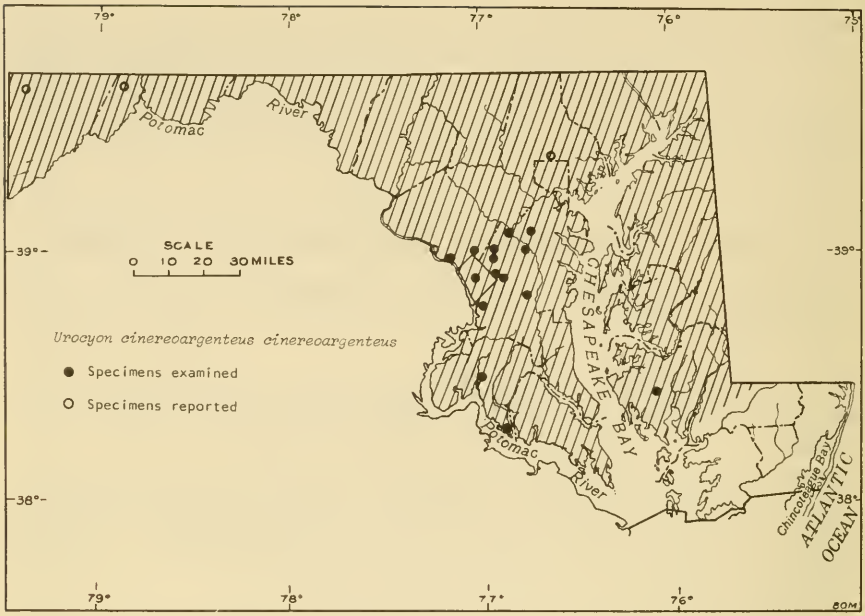

FIGURE 46.—Distribution of *Urocyon cinereoargenteus cinereoargenteus*.

speed and would perhaps have difficulty surviving in wide open areas. On the other hand, it is quite at home in the trees, being more arboreal than the red fox. For protection, it depends to some extent on rocky or brushy cover to which it can retreat, or forests where it can quickly climb a tree to escape a predator. Of 60 gray foxes trapped at the Patuxent Research Center, Prince Georges County, in the 1940's, the majority were taken in hedgerows and margins habitat, and most of the others in bottomland forests (Uhler and Llewellyn, 1952, p. 84).

This species selects a hollow tree or log for a den; occasionally it may use a burrow in the ground. It breeds but once a year, usually in February. Young are born from March to May and may number from two to seven, with the average being four. Both parents take part in caring for the young.

The food of the gray fox varies from season to season. Studies at the Patuxent Research Center (Llewellyn and Uhler, 1952, p. 199) indicate that in late fall and early winter approximately 30 percent of the gray fox's food is plant material, while about 70 percent is animal. Of the plant food consumed, persimmon was the most important item, while corn, pear, apple, and beechnut were also taken. Rodents were by far the most important animal food, but rabbits, birds, and insects were also consumed. Hamilton (1943, p. 177) lists rabbits as the most important food for the species. He also lists birds, small mammals,

particularly field mice, deer mice, wood rats, and shrews, snakes, turtles, and their eggs, lizards, insects, apples, beechnuts, corn, grapes, hickory nuts, persimmons, carrion, wild cherries, and grasses as additional food items.

The species is abundant in the Piedmont, Ridge and Valley, and Allegheny Mountain sections. Forty gray foxes were taken in only 5 weeks in 1946 at Mount Savage, Garrett County (League of Maryland Sportsmen, Rally Sheet 4(10), p. 6, December 1946). The species, however, is not abundant in the Eastern Shore section. In fact, the first gray fox ever taken on the Blackwater National Wildlife Refuge, Dorchester County, was obtained as late as 22 October 1943. Apparently much of the Eastern Shore section is too low, flat, and marshy for the animals' liking.

Specimens examined.—Anne Arundel County: Fort George G. Meade, 1. *Charles County:* La Plata, 1; Rock Point, 1. *Dorchester County:* Blackwater National Wildlife Refuge, 1 (baculum). *Montgomery County:* Plummers Island, 1; Silver Spring, 1. *Prince Georges County:* Beltsville, 1; Berwyn, 2; Landover, 1; Largo, 1; Laurel, 11; Marlboro, 1; Oxon Hill, 1; Patuxent Research Center, 11.

Other records and reports.—Allegany County: Mount Savage (League of Maryland Sportsmen, Rally Sheet 4(10), p. 6, December 1946). *Montgomery County:* Cupids Bower (Bailey, 1923, p. 123.).

Family URSIDAE (bears)

BLACK BEAR

Ursus americanus Pallas

Ursus americanus Pallas, . . . Spicilegia zoologica, . . . fasc. 14: 5, 1780.

Type locality.—Eastern North America.

General distribution.—Wooded areas of North America, from Newfoundland to Alaska, and south into central Mexico.

Distribution in Maryland.—The black bear was once distributed throughout the State, but today is on the verge of extirpation and is found only in restricted areas in the Ridge and Valley and Allegheny Mountain sections.

Distinguishing characteristics.—Teeth 3/3, 1/1, 4/4, 2/3, = 42; largest wild mammal in Maryland; toes armed with strong claws; normal color both above and below black or very dark brown, except for cinnamon patch across muzzle and sometimes a white blotch on throat; pelage harsh and coarse. The black bear is so familiar as to scarcely need description.

Measurements.—"Total length, adult males, 1375 to 1780 mm. (54 to 70 in.); tail, 90 to 125 mm. (3.5 to 5 in.); hind foot, 215–280 mm.

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(8.5 to 11 in.). Weight, adult males, 250 to 500 pounds, rarely 600 pounds or more, normally 300 to 400 pounds. Skull, adult males, length, 270 to 298 mm.; width, 158 to 185 mm. Total length, adult females, 1270 to 1475 mm. (50 to 58 in.); tail 80 to 115 mm. (3 to 4.5 in.); hind foot, 190 to 240 mm. (7.5 to 9.5 in.). Weight, adult females, 225 to 450 pounds. Skull, adult females, length 255 to 285 mm.; width, 148 to 172 mm." (Jackson, 1961, p. 313).

Habitat and habits.—The black bear prefers heavily wooded areas, and is now confined to the wildest and most inaccessible forests of the Allegheny Mountain section. Individuals may occasionally visit well-populated agricultural areas, but they usually do not remain in the neighborhood of humans for any length of time.

Except for females with cubs, the black bear is solitary in habits. It is nocturnal but usually does not wait until full darkness to venture forth; occasionally an individual may be seen abroad in the daytime. These bears remain dormant from about the end of November or early December until March or April, usually in a cavity dug under an overturned tree, most often at the roots. Sometimes other sites are chosen, such as a cave in rocks, a hollow tree, or dense thickets.

The female gives birth in January or February; the gestation period is about 225 days. One to five young may comprise a litter, but the usual number is two. Black bears normally breed only every other year.

The black bear is an omnivorous animal, consuming a wide variety of foods. It is especially fond of fruits and eats large quantities of blueberries, blackberries, strawberries, and raspberries. It also consumes quantities of mice, insects, and fish and occasionally will kill and devour sheep and pigs. In the autumn, when nuts are available, it feeds extensively on acorns and beechnuts. In addition, it will occasionally eat grass, roots, and fungi.

Remarks.—Mansueti (1950, pp. 14–16) has thoroughly investigated the former and present distribution of this species in Maryland. According to him, the black bear was at one time distributed throughout the State and was plentiful. Early settlers considered it the bane of their existence. Today the black bear still exists in restricted portions of the western part of the State, but in the past 2 or 3 decades it has been on the verge of extinction. A 1937 report by the U.S. Bureau of Biological Survey (Big-Game Inventory of the United States, 1937, Wildlife Research and Management Leaflet BS–122, January 1939) placed the total number of bears in Maryland at 150. The 1938 summary (Big-Game Inventory of the United States, 1938, U.S. Bureau of Biological Survey, Wildlife Leaflet BS–142, August 1939) placed the number at 50. By 1946 (Big-Game Inventory of the United States, 1946, U.S. Fish and Wildlife Service, Wildlife Leaflet

303, March 1948) the estimate was down to 25; in 1951 (Inventory of Big-Game Animals of the United States, 1950 and 1951, U.S. Fish and Wildlife Service, Wildlife Leaflet 342, October 1952) to 20; and by 1956 to 12.

Bears are still occasionally seen in Allegany and Garrett Counties. Theodore A. Bookhout, formerly with the University of Maryland's Natural Resources Institute, has informed me of several recent sightings. In the fall of 1963, one was seen near Murley's Branch, a few miles south of Flintstone, Allegany County; in October 1963, one was seen on Maryland Route 55, approximately 2 miles north of Corriganville, Allegany County; on January 3, 1964, bear tracks were seen on Wagner Road just north of Oldtown, Allegany County.

As Mansueti (1950, p. 16) notes, however, western Maryland is becoming more densely populated and the extensive forests are being laid waste, and the black bear will disappear mainly because it is unwanted. At most it will remain in only the most remote and inaccessible of Maryland wildlife sanctuaries.

Family PROCYONIDAE (raccoons, coatis, etc.)

RACCOON

Procyon lotor lotor (Linnaeus)

[*Ursus*] *lotor* Linnaeus, Syst. nat., ed. 10, 1: 48, 1758.

Procyon lotor maritimus Dozier, J. Mammal., 29(3): 286, August 1948. (Type locality: Blackwater National Wildlife Refuge, Dorchester County, Md.)

Type locality.—Pennsylvania (fixed by Thomas, Proc. Zool. Soc. London, p. 140, March 1911).

General distribution.—"Nova Scotia, southern New Brunswick, southern Quebec, and southern Ontario, south through the eastern United States to North Carolina from the Atlantic coast west to Lake Michigan, Indiana, southern Illinois, western Kentucky and probably eastern Tennessee." (Goldman, 1950, p. 33.)

Distribution in Maryland.—Common in all sections of the State, but particularly abundant in the Eastern Shore section.

Distinguishing characteristics.—Teeth 3/3, 1/1, 4/4, 2/2, = 40; size medium; form robust; fur long and coarse; coloration of upper parts grizzled gray, brownish, and blackish, there being considerable individual variation; sides paler than upper parts; under parts dull grayish brown, tinged with yellowish gray or white; black band, or mask, extends through eyes and across cheeks; remainder of face yellowish gray; tail alternately banded brownish gray or blackish and yellow, with five to seven dark rings, always terminating in a dark band.

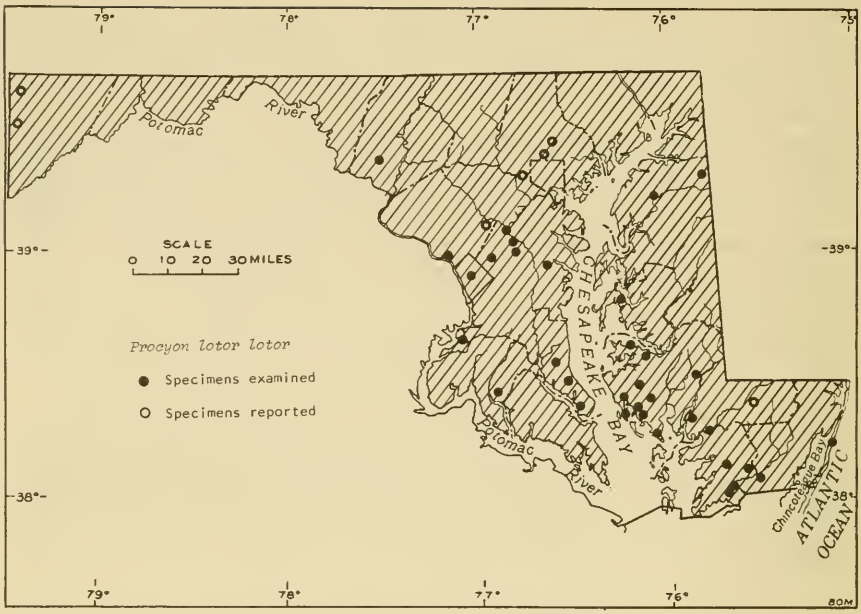

FIGURE 47.—Distribution of *Procyon lotor lotor*.

The racoon is easily distinguished from all other Maryland mammals by the dark facial mask and the long-haired tail ringed with black and yellow.

Measurements.—External and cranial measurements of four adult females from the Blackwater National Wildlife Refuge, Dorchester County, are: Total length 749.5 (718–762); tail 236.7 (210–254); hind foot 108 (102–114); condylobasal length of skull 110.9 (107.1–114.2); zygomatic breadth 67.1 (62.7–69.7); postorbital breadth 23.3 (22.5–23.8); length of maxillary toothrow 41.3 (39.9–43.8); breadth of rostrum at incisors 23.7 (23.1–24.2). External measurements of three and cranial measurements of four adult males are: Total length 736, 736, 762; tail 229, 229, 254; hind foot 102, 102, 102; condylosabal length of skull 114.1 (110.9–117.9); zygomatic breadth 67.4 (64.9–69.9); postorbital breadth 22.5 (21.0–24.7); upper maxillary toothrow 26.1 (25.3–26.5).

Three adult males and three adult females from Laurel, Prince Georges County, measure cranially: Condylobasal length 109.6, 112.7, 111.7, 106.3, 104.4, 108.8; zygomatic breadth 67.4, 67.8, 74.9, 67.7, 68.4, 65.1; postpalatal breadth 24.2, 22.1, 23.5, 22.1, 22.4, 23.2; length of maxillary toothrow 40.9, 41.6, 41.1, 40.7, 39.0, 40.1; breadth of rostrum at incisors 25.6, 25.1, 26.1, 23.5, 22.5, 22.8.

Habitat and habits.—The raccoon is cosmopolitan in habitat preference, being found in woods, swamps, and marshes, including salt-

water marshes of the Atlantic barrier beaches. Uhler and Llewellyn (1952, p. 83) report that at the Patuxent Research Center, near Laurel, Prince Georges County, the outstanding habitat type was bottomland forest, followed by cultivated fields (mainly those with corn), hedge rows and wood margins, particularly if leading to cornfields. Raccoons were also abundant around marshy lake borders and in swamps.

The raccoon is a very adept climber. Although it usually makes its home in a hollow tree, it sometimes will utilize a fissure in a cliff, or a hole among rocks. Raccoons rapidly diminish in numbers when trees are cut over, and will either die off or leave the area after all the trees are gone.

The raccoon is nocturnal, and forages for its food after sunset. Its diet consists of fish, crayfish, frogs, and mussels, as well as poultry, mice, birds, eggs, reptiles, and insects. In season, it eats considerable amounts of vegetable matter such as nuts, fruits, berries, and corn.

In more northern climates the raccoon hibernates, but in Maryland it remains active the year round except in the coldest portions of the western part of the State. The species breeds in January and February, and some 63 days later females give birth to two to six young. The cubs are born blind and remain so for about 19 days; they suckle for 2 months, and remain in the family circle through the winter.

Remarks.—Maryland raccoons differ in no significant way from Pennsylvania and New York specimens. Dozier (1948a, p. 286) separated the raccoons inhabiting the marshes of the Delmarva Peninsula from those living in the surrounding woods as a distinct subspecies, *Procyon lotor maritimus*. I have examined the type of this race, as well as the series designated by Dozier as representing it, and am unable to separate it from raccoons inhabiting other parts of Maryland. All the diagnostic characters mentioned by Dozier (paler coloration; longer but more sparse guard hairs; much smaller size; shorter, more pointed and less prominently banded tail; relatively shorter caudal vertebrae; smaller and more distinctly curved baculum; and various cranial characters) are either within the limits of individual variation of *P. l. lotor*, or are so slightly marked that I have been unable to distinguish them. Consequently, I consider *Procyon lotor maritimus* Dozier to be a synonym of *Procyon lotor lotor* (Linnaeus).

Specimens examined.—Anne Arundel County: Rutland, 1. *Calvert County:* Prince Frederick, 1; St. Leonard (near), 1; Sollers, 9. *Charles County:* Marshall Hall, 1; Newport, 1. *Dorchester County:* Blackwater National Wildlife Refuge, 69; Cambridge, 1; Castlehaven Point, 3; Crapo, 1; Crocheron, 1; Golden Hill, 2; House Point, 11; Kirwan's Neck, 2; Meekins Neck, 1; Punch Island, 6; Robbins (near), 1; Shorters Wharf, 1; Vienna, 1; Worlds End Creek, 1. *Frederick*

County: Jefferson, 2. *Kent County:* Chestertown, 2; Millington (4 miles NE), 1. *Montgomery County:* Cabin John, 1. *Prince Georges County:* Bowie, 1; Branchville, 1; Laurel, 39; Patuxent Research Center, 4. *Somerset County:* Cokesbury, 4; Marumsco, 3; Rehoboth (near), 2; Westover, 2; Whitehaven (across Wicomico River from), 3. *Talbot County:* St. Michaels, 1. *Wicomico County:* Bivalve (near), 1; Whitehaven, 1. *Worcester County:* Assateague Island, 1; Pocomoke City (vicinity), 17. *District of Columbia:* 1.

Other records and reports.—Baltimore County: Bare Hills–Lake Roland area (Bures, 1948, p. 66); Loch Raven (Kolb, 1938); Patapsco State Park (Hampe, 1939, p. 5). *Garrett County:* Blooming Rose (Browing, 1928, p. 26); Cranesville Pine Swamp (Mansueti, 1958, p. 83). *Montgomery County:* Burtonsville (Herman et al., 1957, p. 113–114); Plummers Island (Goldman and Jackson, 1939, p. 132). *Wicomico County:* Salisbury, a few miles east (Kilham and Herman 1955, p. 499).

Family MUSTELIDAE (weasels, skunks, otters, etc.)

ERMINE

Mustela erminea cicognanii Bonaparte

Mustela cigognanii [*sic*] Bonaparte, Charlesworth's Mag. Nat. Hist., 2:37, 1838.

Type locality.—Eastern United States.

General distribution.—Southeastern Ontario, southern Quebec, and Maine, south through extreme northeastern Ohio and Pennsylvania into Maryland.

Distribution in Maryland.—Probably very rare in the Allegheny Mountain, Ridge and Valley, and Piedmont sections, and absent from the Western Shore and Eastern Shore sections. The species is most numerous in the coniferous forests of the northern portion of its range, but even in the north it is uncommon in coastal regions and consequently it probably does not occur in Maryland's coastal plain. It has been reported from the State only once.

Distinguishing characteristics.—Teeth 3/3, 1/1, 3/3, 1/2, = 34; size medium; body long and slender; legs short; tail moderately short, averaging about 35 percent of head and body length, well haired and slightly bushy, tipped with black above and below; coloration of upper parts in summer dark brown extending to the outer parts of the legs and feet; color of underparts whitish, usually tinged with yellow; winter coloration white except for tip of tail which remains black.

This species resembles the long-tailed weasel (*Mustela frenata*) in general appearance and in coloration, but is considerably smaller, and shorter tailed. When using size as a criterion in separating the two species, it is necessary to take into account the sex of the individual.

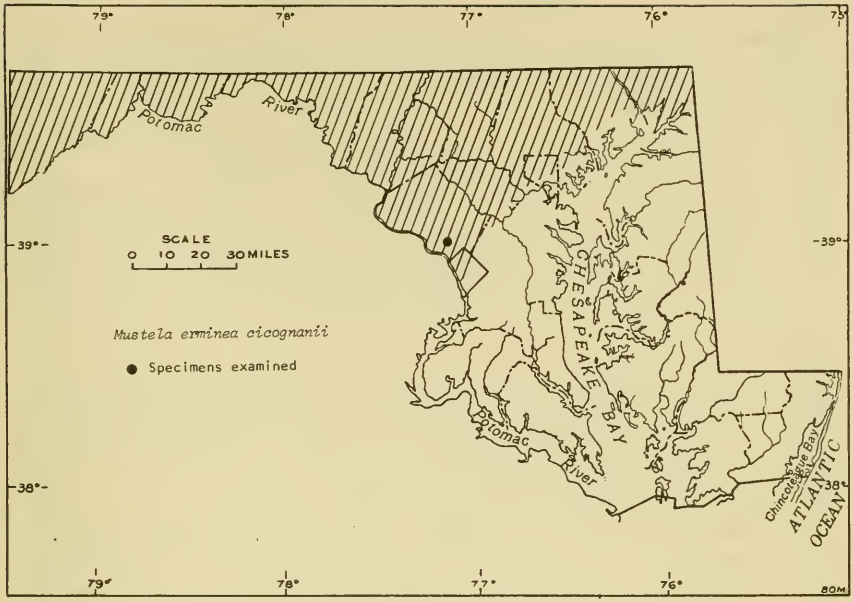

FIGURE 48.—Distribution of *Mustela erminea cicognanii.*

Male and female long-tailed weasels are larger than male and female ermines, but since the males in both species are larger than the females, a large male ermine may approach in size a small female long-tailed weasel.

Measurements.—Hall (1951, p. 119) gives the averages and extremes of external measurements of seven adult and subadult males from New York and Pennsylvania as follows: Total length 266 (240–295); length of tail 74 (66–80); length of hind foot 36 (33–39). He gives the external measurements of 12 adult and subadult females from Maine and the area south to central Pennsylvania as: Total length 243 (225–260); length of tail 63 (55–72); length of hind foot 29.8 (26–32).

Some cranial measurements given by Hall (1951, pp. 434–435) of nine adult and subadult males from New York and Pennsylvania are: Basilar length (of Hensel) 35.7 (33.8–37.6); zygomatic breadth 20.3 (19.0–20.6); interorbital breadth 8.6 (7.7–8.9); mastoidal breadth 18.2 (17.3–18.8). Four adult and subadult females from New York and Pennsylvania measure cranially: Basilar length (of Hensel) 32.4 (31.4–33.3); zygomatic breadth ——, ——, 17.5, 18.0; interorbital breadth 7.5 (7.2–7.8); mastoidal breadth 15.7 (average of 3, 15.3–16.0).

Vasquez (1956, p. 114), who collected the only Maryland record of this species, says that no external measurements are available for the specimen, but he does give the following cranial measurements for the female: Condylobasal length 38.1; basilar length (of Hensel) 34.3; mastoidal breadth 17.1; depth of skull at first molars 9.1.

Habitat and habits.—This animal is most abundant in the northern United States and Canada where it inhabits the deep spruce stands. In the southern part of its range it is often encountered in brushy fields and hedgegrows, and it is particularly fond of stone walls, where it can elude its enemies and catch the small mammals and birds which form its prey.

This weasel generally does not make its own home, but prefers to occupy the chambers of some other mammal, most often a chipmunk's cavity beneath a stump or pile of rocks. Its nest is composed of fur and feathers from the animals on which it feeds.

According to Hamilton (1943, p. 136) all the evidence suggests that these weasels mate in the early summer, and the fertilized eggs, after undergoing a short development remain quiescent for several months. Embryonic development continues in the late winter, and the four to nine young are born usually in mid-April. Hamilton states that the male weasel assists in bringing food to the young during their infancy and that there is much evidence that weasels remain paired throughout the year.

Hamilton (1933b, p. 333) reports fall and winter food of 191 ermine in New York State as composed of the following: Meadow mice 35.7 percent; undetermined mammals (principally mice) 16.3 percent; short-tailed shrews 15.1 percent; white-footed mice 11.4 percent; rabbits 9.0 percent; long-tailed shrews 4.9 percent; rats 4.4 percent; and chipmunks 3.6 percent. In addition, birds comprised some 2.1 percent, and reptiles and amphibians 1.2 percent of the fall and winter food of weasels (354 *Mustela erminea* and *Mustela frenata*).

Remarks.—This species has been recorded only once from Maryland. Vazquez (1956, pp. 113–114) reports that a cat killed an ermine on the heavily wooded grounds of the Honeywell School, 4 miles northwest of Bethesda, Montgomery County, on 27 May 1954. Prior to this, Maryland was considered far south of the normal range of the ermine, and it is possible that the animal escaped from captivity. Vazquez states that the coloration is peculiarly grayish, and that its cranial measurements are slightly larger than those of female *Mustela erminea cicognanii* and approach those of males of this race. The skin and skull of the specimen are in Vazquez' private collection and I have not examined them.

LONG-TAILED WEASEL

Mustela frenata noveboracensis (Emmons)

Putorius Noveboracensis Emmons, a report on the quadrupeds of Massachusetts, p. 45, 1840.

Type locality.—Williamstown, Berkshire County, Mass.

General distribution.—From Wisconsin east through Michigan, southwestern Ontario, southern Quebec, and southeastern Maine, south through the eastern United States to North Carolina, western South Carolina, northern Georgia, and Alabama, west to the Mississippi and St. Croix Rivers.

Distribution in Maryland.—Occurs in all sections of the State.

Distinguishing characteristics.—A large weasel, similar in coloration and general appearance to the ermine, but larger and with a longer tail. It is generally believed that except in the coldest portions of the Allegheny Mountain section, most Maryland long-tailed weasels remain in brown pelage the year round, and the majority of winter-killed specimens from Maryland that I have examined are in brown pelage. There is, however, one male from Gaithersburg, Montgomery County, and another from Patuxent, Prince Georges County, in the National collections that are entirely white except for the customary black tail tip.

Male long-tailed weasels are strikingly larger than females. So pronounced is this secondary sexual trait that some early writers

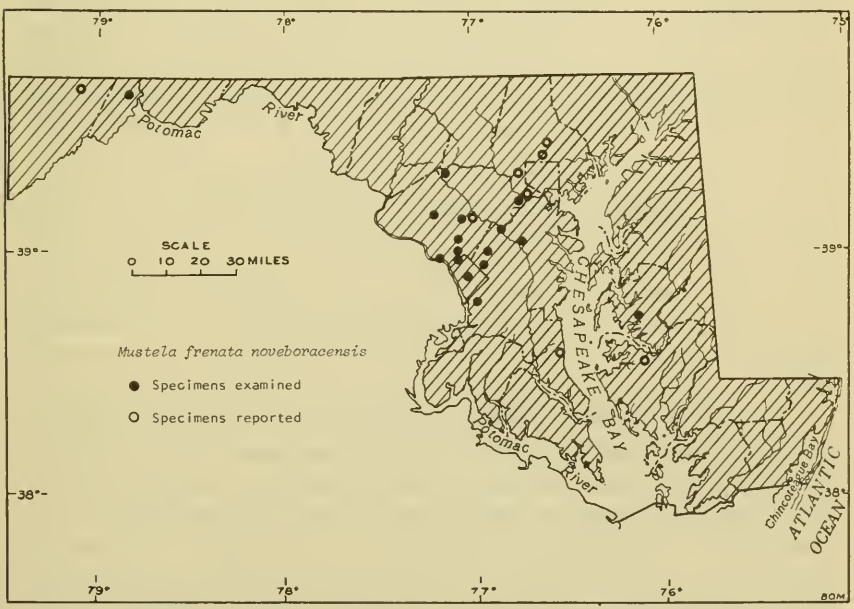

FIGURE 49.—Distribution of *Mustela frenata noveboracensis*.

thought the two sexes must represent distinct species. Since the female long-tailed weasel is so small, it is possible to mistake her for an ermine, and due allowance must be made for sex when separating these species on the basis of size.

Measurements.—External measurements of 12 adult males from various parts of Maryland are: Total length 382 (340–429); tail 131.6 (110–155); hind foot 48 (34–48). Seven females from various parts of the State have the following external measurements. Total length 286.6 (253–315); tail 93.1 (80–122); hind foot 34 (32–38).

Cranial measurements of 10 adult males from Laurel, Prince Georges County, are: Basilar length 42.7 (40.8–44.3); zygomatic breadth 25.6 (23.5–27.3); interorbital breadth 9.8 (9.0–10.8); mastoidal breadth 22.4 (21.4–24.0). Cranial measurements of three adult females from Laurel are: Basilar length 36.1, 36.4, 36.5; zygomatic breadth 21.5, 21.7, ——; interorbital breadth 7.9, 9.1, 9.1; mastoidal breadth 18.9, 19.0, 18.2.

Habitat and habits.—This weasel prefers bushy field borders, brushland, open woodland, and woodland bordering cultivated fields and pastures. It is quite adaptable and willing to live in close proximity to man as long as suitable prey is available. Recently, I found one dead on a road in the middle of Kensington, Montgomery County, where the only suitable habitat for some distance was the bushy area bordering a railroad track that runs through the center of town. Uhler and Llewellyn (1952, p. 81) report that during a study made at the Patuxent Research Center in Prince Georges County, only four weasels were taken in three trapping seasons. Of these, two were taken along hedgerows, one in upland forest, and one along the Patuxent River. In the Bare Hills–Lake Roland area, Bures (1948, p. 66) thought these weasels were quite rare at first. Subsequent investigation revealed, however, that they were more common than he suspected, and that they range throughout the area except for the marsh and Serpentine. He says that they seem to use the railroad right-of-way as a natural highway regularly; their mortality rate was high there, since an average of four specimens a year were recorded killed by passing trains. In an area as small as that in which Bures was working, this is a high number of weasels.

This species generally does not make its own burrow, but uses an abandoned one of a chipmunk or mole. Sometimes it will utilize a hole among rocks or under a stump. The nest center is usually filled with grass and lined with fur and feathers from the weasel's prey.

Mating in this species occurs in July and August. The gestation period is very prolonged, averaging about 279 days, but as in the ermine, the embryo remains quiescent throughout most of this period and only begins to develop rapidly during the last 27 days. The young,

numbering between six and eight, are born from mid-April to mid-May. Hamilton (1933b, p. 328) states that the male stays with the female and assists in caring for the young. He says that he has several times seen a male of this species carrying food to a den of young ones.

Like the ermine, the long-tailed weasel is strictly carnivorous in diet. Hamilton (1933b, p. 333) lists the percentages of fall and winter food of this species in New York State as follows: Meadow mice 33.6; cottontail rabbits 17.3; white footed mice 11.3; rats 9.1; short-tailed shrews 5.9; squirrels 2.7; chipmunks 1.0; star-nosed moles 0.8; muskrat 0.8. In addition to this, a small percentage of birds and reptiles is consumed.

Specimens examined.—Allegany County: Piney Mountain, 2 (Coll. U. Md.). *Anne Arundel County:* Patuxent (2 miles S), 1. *Howard County: Hanover*, 1; Long Corner, 1. *Montgomery County:* Bethesda, 1; Chevy Chase, 1; Foxhall Village (D.C.? not located in Maryland), 1; Gaithersburg, 1; Garrett Park, 1; Kensington, 1; Linden, 1; Olney, 1; Plummers Island, 3. *Prince Georges County:* Andrews Air Force Base (near), 1; Bladensburg, 1; Branchville, 1; Laurel, 17; Oxen Hill, 1. *Talbot County:* Easton, 1. *District of Columbia:* 8.

Other records and reports.—Baltimore County: Bare Hills–Lake Roland area (Bures, 1948, p. 66); Halethorpe (Hampe, 1943, p. 66); Loch Raven (Seibert, 1939, p. 21); Patapsco State Park (Hampe, 1938, p. 6). *Calvert County:* Plum Point (identified from photograph submitted by John F. Fales). *Dorchester County:* Cambridge (five specimens in collection of R. W. Jackson, examined by Hall, 1951, p. 228). *Garrett County:* Grantsville (E A. Preble, in field notes, mentions seeing one, June 1899). *Montgomery County:* Sandy Spring (Bailey, 1923, p. 126).

(LEAST WEASEL)

Mustela nivalis allegheniensis (Rhoads)

Putorius allegheniensis Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 52: 751, 25 March 1901.

Type locality.—Near Beallsville, Washington County, Pa.

General distribution.—From Wisconsin and northern Illinois eastward through northern Indiana, Michigan, and Ohio into southwestern New York and Pennsylvania, thence southward in the Appalachians to North Carolina.

Distribution in Maryland.—This species has not been recorded as yet from Maryland, but it has been taken in nearby Pennsylvania, West Virginia, and Virginia, and probably ranges through the Allegheny Mountain section of Maryland and possibly in the Ridge and Valley section as well.

Distinguishing characteristics.—A very small weasel, similar to both *M. frenata* and *M. erminea* in coloration and general form, but

considerably smaller than either. It may readily be distinguished from both these species by its very short tail and the complete lack of a black tail tip.

Measurements.—"Male: An adult or subadult from Fair Oaks, Pa., a subadult from Finleyville, Pa., and an adult from Huttonsville, W. Va., measure respectively as follows: Total length, 206, 194, 191 (average 197); length of tail, 37, 32, 28 (32); length of hind foot, 23 in each.

"Female: Two young from Leasuresville, Pa., and Middle Paxton Twp., Pa., measure respectively, as follows: total length, 188, 172; length of tail, 33, 30; length of hind foot, 20.5, 21." (Hall, 1951, p. 187–188.)

Some of the cranial measurements listed by Hall (1951, p. 440–441) of an adult male from Huttonsville, W. Va., and an adult female from Beallsville, Pa., are Basilar length (of Hensel) 28.5, 28.0, zygomatic breadth 16.7, 14.6; interorbital breadth 7.1, 6.2; mastoidal breadth 15.1, 13.5.

Habitat and habits.—This species inhabits both the deep forests and the fields and pastures within its range. It is a rare mammal however, and is seldom encountered.

Little is known of its habits. Hamilton (1943, p. 139) says that nests have been found beneath corn shocks, in shallow burrows bordering streams, and in similar places. The few nests that have been discovered were composed of grasses and mouse fur. Hamilton states that the breeding habits of this species apparently differ from those of its larger relatives. He says that young with unopened eyes have been discovered in midwinter, while nest young and lactating females have been found in Pennsylvania during October, January, and February. These litters numbered from three to six young. The female parent was always in attendance. From this he says that the young are probably born at various seasons and there is a likelihood of more than one litter a year.

Hall (1951, p. 177) says that food of the least weasel consists of harvest mice, deer mice, meadow mice, red-backed mice, and possibly insects.

MINK

Mustela vison mink Peale and Palisot de Beauvois

Mustela mink Peale and Palisot de Beauvois. A scientific and descriptive catalogue of Peal's museum, Philadelphia, p. 39, 1796.

Type locality.—Maryland.

General distribution.—Eastern United States from southeastern Maine, south to coastal North Carolina, and inland (excepting the higher elevations of the Appalachians) through Pennsylvania, Michigan, Georgia, and Alabama to Missouri.

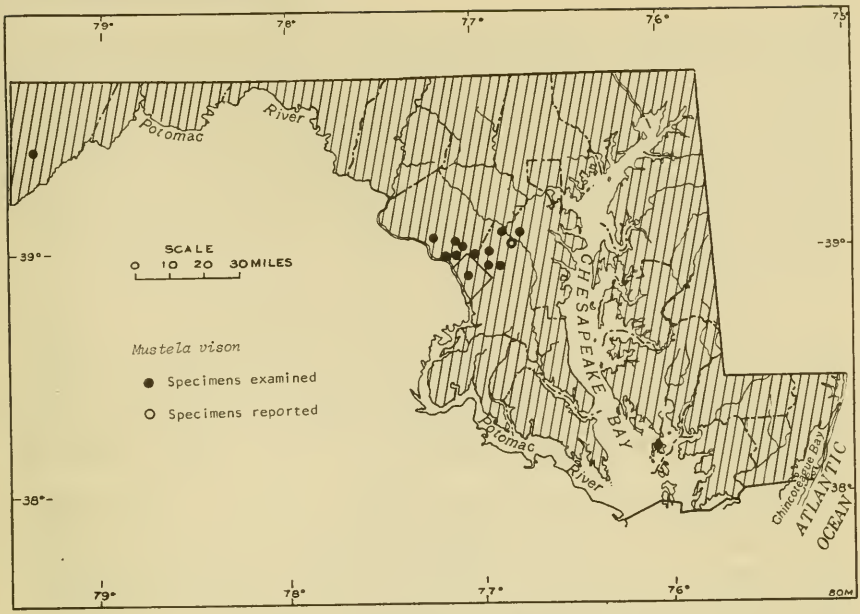

FIGURE 50.—Distribution of *Mustela vison*.

Distribution in Maryland.—The species is Statewide in distribution; the subspecies *mink* occurs throughout most of Maryland, but may be replaced by the race *vison* at higher elevations in the Allegheny Mountain section. This very dark northern race, *vison*, has been reported in the Appalachians to the south of Maryland (Kellogg, 1939, p. 262), but the only specimen available from the Allegheny Mountain section of Maryland is a zoo animal and its subspecific affinities are indeterminable.

Distinguishing characteristics.—A very large weasel, with a fairly long, bushy tail; coloration dark glossy brown over entire body, except for a whitish chin spot and an occasional white streak on the neck or white spot on the chest or belly; pelage thick and dense, adapted for an aquatic life.

The mink may distinguished from the long-tailed weasel by its larger size, and absence of a white belly. It is similar to an otter in coloration, but is smaller and does not have a broad-based tail.

Measurements.—Males considerably larger than females. A typical adult male and female from Montgomery County have the following external and cranial measurements: Total length 650, 547; tail 225, 193, hind foot 70, 54; basilar length 62.4, 56.0; zygomatic breadth 42.1, 36.3; interorbital breadth 12.9, 13.7; mastoidal breadth 34.4, 30.5.

Habitat and habits.—The mink always lives near water. It is found around lakes, in or near marshes, and along the banks of rivers or

streams. It prefers forested, log-strewn, and bushy areas. At the Patuxent Wildlife Research Center near Laurel, Prince Georges County, Uhler and Llewellyn (1952, p. 84) found them along lake margins, by a small stream, and along the Patuxent River. Bailey (1923, p. 125) reported that in the early 1920's they were fairly common along the banks of almost any stream in Washington, D.C., and that they followed Rock Creek well down into the city. Today, owing to stream pollution and other factors few, if any, mink occur along Rock Creek in Washington.

Mink make their home under large trees which line banks of streams along which they live. They also inhabit muskrat lodges or natural cavities along the banks of streams, rivers, lakes, or marshes. Males and females build separate nests, but females build more elaborate ones, lining them with grass, feathers, and fur to make a snug home for the young.

The breeding season for mink begins in January and extends through March; the gestation period is variable, from 39 to 76 days, depending on when mating has occurred; the later the mating, the shorter the gestation period. Three to six young are born in April or May, but as many as 10 have been reported.

Mink range over a wide area to procure their food, which consists of any reptiles, amphibians, small mammals, and birds obtainable. In areas where muskrat abound, such as the muskrat marshes of the Delmarva Peninsula, mink may feed extensively on them. Llewellyn and Uhler (1952, p. 199), in studies conducted at the Patuxent Research Center, report that it is usually difficult to get food-habits material from trapped mink since their digestion is so rapid. They state that frequently stomachs of the animals studied were empty, and only digested blood was found in the intestines. They were only able to obtain six stomachs and four scats suitable for tabulation. In none of these was there any plant food except for a few poison-ivy seeds which were found in a stomach that contained flicker remains. Presumably the bird had eaten these seeds before being captured by the mink. One mink sample in March and another in December contained rabbit hair only. Five other winter samples had 100 percent rodent remains consisting of one meadow mouse, three pine mice, and one "wood" mouse. In the two additional stomachs examined by Llewellyn and Uhler, one contained flicker remains and the other had a beetle fragment.

The mink sometimes does considerable damage to poultry. Bailey (1923, p. 125) says that he was told of a mink in the Washington area that visited a henhouse and killed 22 chickens in one night and returned the next night to kill 16 more. The following night, as the mink was returning to the henhouse again, it was caught by a dog.

Despite the great number being bred in captivity, wild-caught mink are still in some demand for their fur, and each year many are trapped throughout the country. Maryland does not rank high in wild mink production. In 1966, only 303 mink were reported trapped in the State (U.S. Fish and Wildlife Service, Fur Catch in the United States, 1966, Wildlife Leaflet 478). The high point in mink trapping in Maryland over the past decade was reached during the 1950–51 season when 4,370 animals were taken (U.S. Fish and Wildlife Service, Fur Catch in the United States, 1949–54, Wildlife Leaflet 367) for their pelage.

Specimens examined.—Anne Arundel County: Little Patuxent River, 1. *Dorchester County:* Bloodsworth Island, 1. *Garrett County:* Oakland (through National Zoological Park), 1. *Montgomery County:* Bethesda, 1; Cabin John, 2; Forest Glen, 2; Garrett Park, 1; Potomac, 1; Sligo Creek (near Takoma Park), 1; no exact locality, 2. *Prince Georges County:* Bladensburg, 1; Branchville, 2; College Park, 1; Lanham, 1; Laurel, 44; no exact locality, 1.

Other records and reports.—Montgomery County: Plummers Island (Goldman and Jackson, 1939 : 132). *Prince Georges County:* College Station, 8 miles NE of Washington; Patuxent Research Center. (Uhler and Llewellyn, 1952, p. 84).

STRIPED SKUNK

Mephitis mephitis nigra (Peale and Palisot de Beauvois)

Viverra nigra Peale and Palisot de Beauvois, A scientific and descriptive catalogue of Peale's museum, Philadelphia, p. 37, 1796.

Type locality.—Maryland.

General distribution.—New England and southern Ontario south to Virginia, and west of the Allegheny Mountains from the lower peninsula of Michigan and southern Illinois south to central Mississippi, Alabama, and Georgia.

Distribution in Maryland.—Distributed throughout the State, but most abundant in the Allegheny Mountain, Ridge and Valley, and Piedmont sections; scarce or lacking in many areas of the Eastern Shore section. According to the Service Survey (U.S. Fish and Wildlife Service, vol. 3(4), p. 15, December 1943), with the breaking up of the former dense forest cover the striped skunk seems to be slowly making its way southward along the Delmarva Peninsula into Dorchester County from Talbot County.

Distinguishing characteristics.—Teeth 3/3, 1/1, 3/3, 1/2, = 34; size large; body heavy, particularly rearward; tail very thick and bushy; legs short; pelage dense and coarse; coloration black with a thin white stripe medially on the nose, and two white stripes running from head to tail. The amount of white on the striped skunk is subject

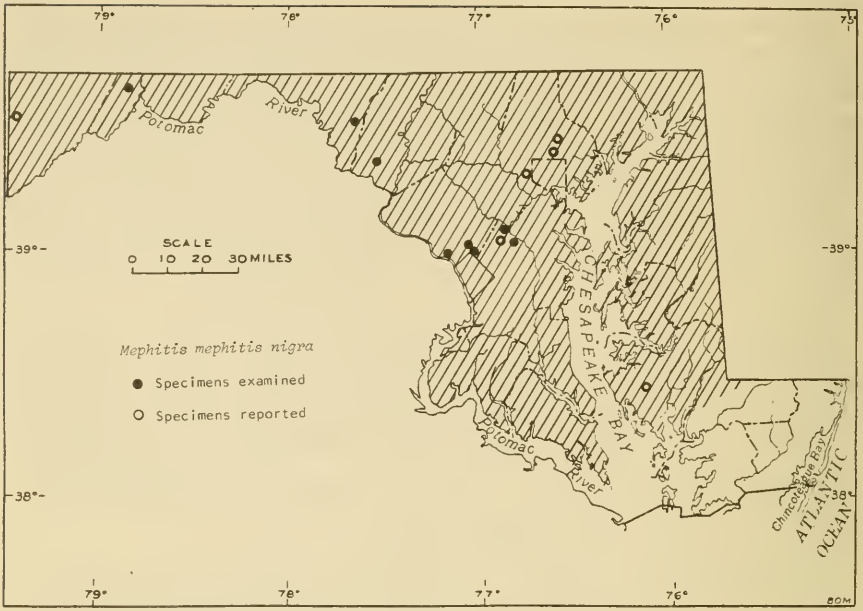

FIGURE 51.—Distribution of *Mephitis mephitis nigra.*

to considerable individual variation. Some animals are almost completely black, while others are predominately white on the back.

This species cannot be confused with any other Maryland mammal except possibly the spotted skunk (*Spilogale*), from which it differs in larger size and in having two rather than four white dorsal stripes. In *Mephitis* the nose patch is always a slender stripe, whereas in *Spilogale* it is a broad triangular patch.

Measurements.—Two adult males and two adult females from Cabin John, Montgomery County, have the following external and cranial measurements: Total length 597, 648, 568, 648; tail 228, 260, 235, 270; hind foot 64, 70, 57, 67; basilar length of skull 61.5, 60.5, 55.0, 60.0; zygomatic breadth 43.2, 46.7, 41.4, 41.9; least interorbital breadth 18.8, 19.6, 19.2, 18.1; maxillary toothrow 21.3, 20.7, 20.2, 20.5.

Habitat and habits.—This skunk is found in brushland, sparse woods weedy fields or pastures, under wood piles and rock piles, and around buildings. It is most common along brushy borders of streams and in rock piles and thickets at the base of cliffs.

The striped skunk makes its home in a burrow which it may dig in a brushy area or pasture, or it may occupy the burrow of some other animal such as a woodchuck. Occasionally the den may be in a cave or under a log or stump. Burrows average between 18 and 20 feet long and may reach to a depth of 3 to 4 feet below the surface of the ground.

The nest within the burrow is a somewhat wider area lined with dry leaves and grass.

The striped skunk is polygamous, and mating occurs from February until March, with the young being born in May or June. Only one litter is produced annually, and between two and 10 (usually six or seven) kits comprise a litter. The gestation period is 60 to 62 days.

Llewellyn and Uhler (1952, p. 200) studied the food habits of skunks at the Patuxent Wildlife Research Center, Prince Georges County. The results of their examination of 63 digestive tracts and 33 scats mostly taken in fall and winter are summarized as follows:

Plant material comprised some 10 percent of the food intake. The only plant item found regularly in the stomach was persimmon, which accounted for about 7 percent. Also occasionally found were beechnuts, acorns, corn, wheat, pokeberry, blackgum, smilax, and a few other fruits and berries; some of this plant material was apparently garbage. Animal matter comprised between 80 percent and 90 percent of the food intake; insects formed almost half of the total and were most prominent in the fall. About 20 percent of the insects consumed consisted of beetles, with scarabs such as June beetles (mostly larvae) and Japanese beetles (mostly adults) leading the list. Ground beetles were also found frequently. The next highest group (11 percent) was made up of grasshoppers and crickets. A large number (5 percent) of true bugs, chiefly stink bugs, were eaten. In later summer and fall, it was evident that in several instances the skunks had dug out yellow-jacket nests and eaten the occupants. Lamore (1953, p. 80) reports that he found a striped skunk dead on the highway near Beltsville, Prince Georges County, in August 1962. The animal's stomach was filled with yellow jackets.

Rodents, chiefly wood mice, meadow mice, and squirrels, comprised 15 percent of the diet; eight occurrences of rabbit totaled 5 percent. Llewellyn and Uhler (1952, p. 200) believe that the squirrels and rabbits were probably road kills, carrion, or hunting cripples, although remains of rabbits that could have been nestlings were found in two scats. Birds were found in 14 stomachs or scats and made up 7 percent of the volume. One box turtle, one king snake, and several undetermined snakes and salamanders were also found. Millipedes were found frequently in fall and winter and often made up entire meals. Spiders also appeared often, and centipedes occasionally, but their remains consisted mostly of legs, so that their volume constituted a small percentage of the total.

This skunk, like its spotted relative, possesses a powerful scent as a defense mechanism. The fluid which contains the scent can be ejected for a considerable distance, and if it should strike one's eye it will cause burning and smarting. Burning can be relieved by washing

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the eye in lukewarm water, followed by flushing with boric acid. Turpentine is useful for removing skunk odor from clothing and from skin, and tomato juice is also effective.

Skunk fur is commercially valuable, and in the 1965–66 trapping season, 161 striped skunks were reported taken in Maryland by fur trappers (U.S. Fish and Wildlife Service, Fur Catch in the United States, 1966, Wildlife Leaflet 478).

Specimens examined.—Allegany County: Mount Savage, 1 (Coll. U. Md.). *Frederick County:* Jefferson, 1. *Montgomery County:* Cabin John, 4; Forest Glen, 1; Silver Spring, 1. *Prince Georges County:* Laurel, 6; Patuxent Research Center, 2. *Washington County:* Boonesboro, 1.

Other records and reports.—Baltimore County: Bare Hills–Lake Roland area (Bures, 1948, p. 66); Loch Raven (Kolb, 1938); Patapsco State Park (Hampe, 1939, p. 6). *Dorchester County:* Blackwater National Wildlife Refuge (Service Survey, U.S. Fish and Wildlife Service, 3(4), p. 15, December 1943). *Garrett County:* Cranesville Pine Swamp (Mansueti, 1958, p. 83). *Montgomery County:* Plummers Island (Goldman and Jackson, 1939, p. 132). *Prince Georges County:* Beltsville, near (Lamore, 1953, p. 80).

EASTERN SPOTTED SKUNK

Spilogale putorius putorius (Linnaeus)

[*Viverra*] *putorius* Linnaeus, Syst. nat., ed. 10, 1 : 44, 1758.

Type locality.—South Carolina.

General distribution.—"Southeastern United States from Alabama, Mississippi, and northern Florida northward through western and central Georgia and South Carolina and northward in the Appalachian Mountains to south-central Pennsylvania." (Van Gelder, 1959, p. 225).

Distribution in Maryland.—Ridge and Valley and Allegheny Mountain sections.

Distinguishing characteristics.—Teeth 3/3, 1/1, 3/3, 1/2, = 34; size small; coloration striking, the background being black, striped with four white dorsal stripes which run about to the middle of the back, the center ones being somewhat narrower than the outer; stripes breaking up into patches on the hind quarters, giving the skunk a spotted appearance; broad triangular white patch on nose and forehead; small white patch in front of ears; tail long and full, broadly tipped with white.

This skunk is readily distinguished from the striped skunk (*Mephitis mephitis*) by the patterning of its coloration. *Spilogale* has four white stripes on the body whereas *Mephitis* has two (these may be highly variable, however, in length and breadth). *Spilogale* has a

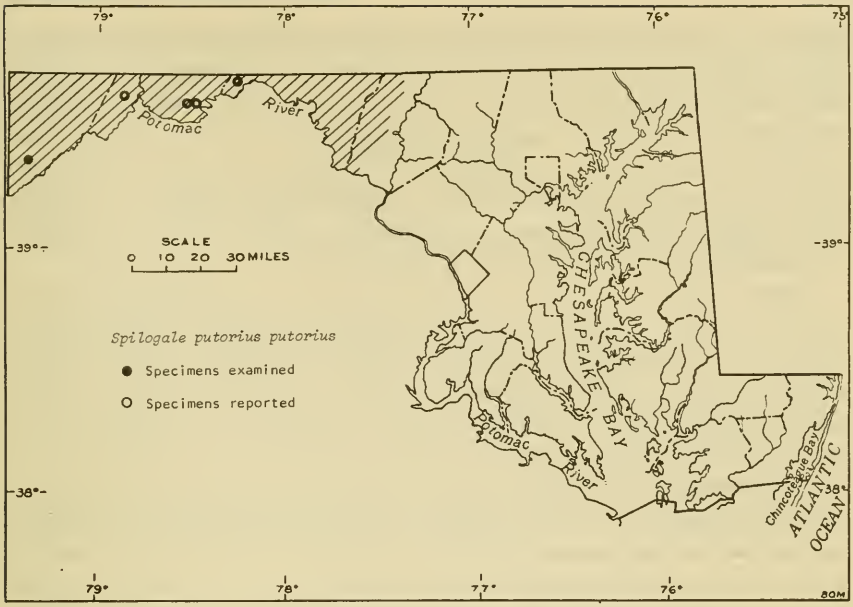

FIGURE 52.—Distribution of *Spilogale putorius putorius*.

broad triangular white nose patch, while *Mephitis* has only a thin white stripe medially on the nose. The spotted skunk is considerably the smaller species.

Measurements.—Van Gelder (1959, p. 255) gives external and some cranial measurements of this subspecies as follows: Males: Total length 506.6 (453–610); tail 180.9 (152–211); hind foot 47.8 (41–51); condylobasal length of skull 57.2 (53.6–61.9); zygomatic breadth 35.3 (32.5–37.8); interorbital breadth 15.5 (13.5–16.9); length of maxillary toothrow 18.4 (17.0–20.5). Females: Total length 450.7 (403–470); tail 171.9 (154–193); hind foot 44.0 (39–47); basilar length of skull 47.6 (45.0–50.0); zygomatic breadth 33.2 (31.8–34.8); interorbital breath 15.0 (13.5–15.9); length of maxillary toothrow 17.7 (16.6–18.6).

A male from Piney Mountain, one-quarter mile north of U.S. Route 40 at Clarysville, Allegany County, has the following external and cranial measurements: Total length 425; tail 155; hind foot 45; ear 13; condylobasal length of skull 55.1; zygomatic breadth 34.1; interorbital breadth 14.8; length of maxillary toothrow 17.7.

Habitat and habits.—In the northern part of its range this species prefers to live in rock piles and crevices in cliffs. In more southern areas of the southeastern United States it often inhabits wasteland and cultivated fields and sometimes build its nest under farm buildings or lives in deserted woodchuck burrows. All of the areas in which

spotted skunks have been taken or observed in Maryland are similar. They are at or near the summits of mountains at altitudes above 1,600 feet. They are characterized by rocky outcrops which run parallel to the summits and which may be several hundred feet in length. The vegetation consists of second-growth oaks (*Quercus* spp.) and hickories (*Carya* spp.), with black locust (*Robinia pseudocacia*), Virginia pine (*Pinus virginiana*), and dense tangles of wild grape (*Vitis* spp.) occasionally present (Bookhout, 1964, p. 214).

Little is known of the breeding habits of the spotted skunk. Van Gelder (1959, p. 260–270) says that there is evidence that this subspecies has an extended breeding period, or that two litters a year might be produced since there are records of females nursing in both the spring and fall. There are between two and six young, with the usual number being four or five.

According to Hamilton (1943, p. 159) the food of this species during the winter months consists largely of rabbits, mice, and other small mammals; during the summer and fall it fattens on fruits, insects, and birds. Lizards, small snakes, and offal are not disdained, and the spotted skunk will steal eggs and kill chicks. It is fond of persimmons and various other fruits in season.

This skunk possesses a means of defense consisting of a characteristic evil-smelling fluid which is secreted by two anal glands. This fluid, or musk as it is sometimes called, can be ejected accurately up to several feet in the direction of attackers. It is more overpowering, blinding, and burning than that of *Mephitis*, and there are few animals that are not repulsed by it.

Specimens examined.—Allegany County: Piney Mountain, ¼ mile N of U.S. Route 40, at Clarysville, 1 (specimen taken 10 February 1964). *Garrett County:* Locklynn Heights, 1 (specimen taken in mid-January 1963).

Other records and reports.—Latham and Studholme (1947, p. 409) report a specimen from 4 miles west of Hancock, Washington County. James H. Beal, of Frostburg, tells me (in correspondence) that he collected a specimen on Town Hill (Mountain), Allegany County, near the beacon light in August 1962, and another near the same locality in 1959. The following records are from Bookhout (1964, p. 214): Green Ridge Mountain (elevation 1,400 ft.), Allegany County (one animal seen in December 1957); and Dan's Mountain (elevation 1,600 ft.), Allegany County (four specimens trapped since 1960).

Remarks.—The spotted skunk is essentially a southern species and has apparently extended its range into Maryland and Pennsylvania only within recent years. The first record of a spotted skunk in Pennsylvania was as recent as 40 years ago (Latham and Studholme, 1947,

p. 409) despite the fact that trappers, hunters, and collectors have been working in the Maryland and Pennsylvania mountains since Colonial times.

RIVER OTTER

Lutra canadensis lataxina F. Cuvier

Lutra lataxina F. Cuvier, *in* Dictionnaire des sciences naturelle . . . 27: 242, 1823.

Type locality.—South Carolina.

General distribution.—Coastal Plain and Piedmont of the eastern United States, from western Connecticut and southern New York, south to South Carolina.

Distribution in Maryland.—The species is statewide in distribution. The subspecies *lataxina* inhabits the Eastern Shore, Western Shore, and Piedmont sections, but may be replaced by *Lutra canadensis canadensis* in the Ridge and Valley and Allegheny Mountain sections where it is scarce or possibly absent (Bookhout, in correspondence). No specimens are available to establish the subspecific identity of the western Maryland otters (if they occur there), but since *L. c. canadensis* has been reported from the mountains of Virginia to the south (Handley and Patton, 1947, p. 133) and West Virginia to the west (Kellogg, 1937, p. 453), western Maryland specimens, if and when obtained, probably will prove referable to *L. c. canadensis.*

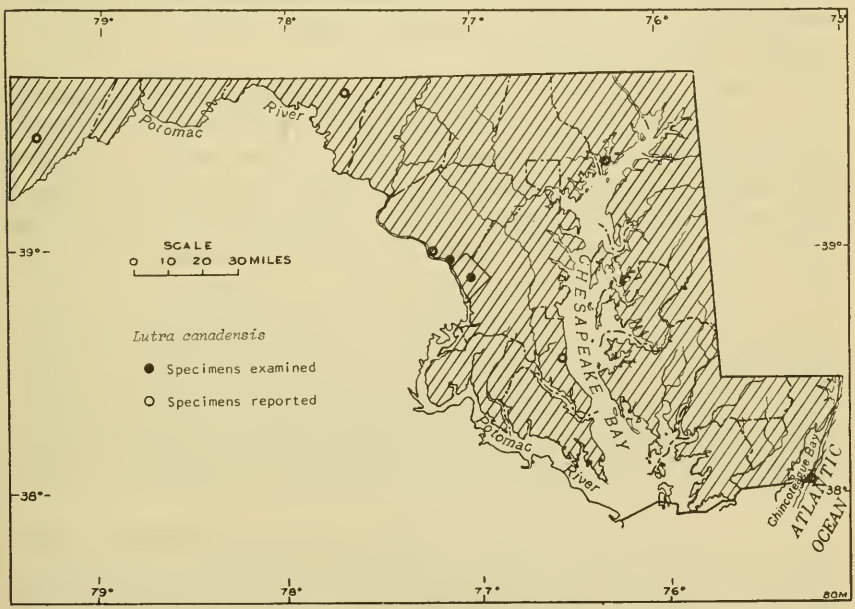

FIGURE 53.—Distribution of *Lutra canadensis.*

Distinguishing characteristics.—Teeth 3/3, 1/1, 4/3, 1/2, = 36; size large; body slender and elongated; head small, broad, and flattened; ears and eyes small and rounded; nose broad and flat; tail long, about a third of the total length of the animal, very heavy at the base and tapering toward the tip; legs very short, ending in large feet with webbed toes; pelage consisting of a dense underfur overlaid with silky guard hairs; coloration a rich deep brown, generally somewhat paler on the belly and often with a grayish mixture on the lips, chin, and throat. The subspecies *L. c. canadensis* is similar to the above but considerably darker in coloration.

The combination of large size, flat, broad head, thick, heavy tail, and webbed toes distinguish the otter from similar mammals in Maryland.

Measurements.—No external measurements are available for the Maryland and District of Columbia specimens in the National collections. Handley and Patton (1947, p. 134) give the range of external measurements in otters as follows: Total length 900–1,200; tail 300–400; hind foot 100–120.

A young male from Glen Echo, Montgomery County, and an unsexed (but apparently a male) old adult from Washington, D.C., have the following cranial measurements: Basilar length 95.8, 101.6; zygomatic breadth 65.3, ——; postorbital breadth 19.1, 20.7; mastoidal breadth 62.9, 66.7; length of maxillary toothrow 35.2, 38.8. Two unsexed (but apparently female) adults from Washington, D.C., measure cranially: Basilar length 87.5, 90.6; zygomatic breadth 64.3, ——; postorbital breadth 17.2, 19.2; mastoidal breadth 56.7, 59.9; length of maxillary toothrow 32.9, 34.2.

Habitat and habits.—The otter occurs along rivers, streams, and lakes, and it appears to be quite common in the marshes that border the Chesapeake Bay and the Atlantic Ocean. It occurs on Assateague Island, where Jacob Valentine, former manager of the Chincoteague National Wildlife Refuge, told me that as many as seven were living in 1958. Most of these, however, were in the Virginia portion of the island, on the Refuge.

Maryland's Eastern Shore supports a large population of otter. Audubon and Bachman (1851, p. 11) and Coues (1877, p. 211) reported them as common there in the 19th century. Brayton (1882, p. 58) says that the Eastern Shore of Maryland appears to have always been a favorite resort of the otter. Another area where this species is abundant is on the Proving Grounds near Edgewood Arsenal, Harford County.

Otters were at one time relatively common along the Potomac River and its tributaries in the vicinity of Washington, D.C., and have often been reported from the city proper. Bailey (1923, p. 125) records an otter at the north end of Rock Creek Park in 1920 and one taken at

Eastern Branch near Bennings in 1895. In nearby Maryland he reports that otter tracks were seen on Plummers Island in 1910 and 1922, and that one was observed swimming across the Potomac River near Seneca in April 1920. Otters still are not uncommon along the Potomac River both to the north and south of Washington. L. G. Henbest observed one swimming in the Potomac near Great Falls in late January and February 1964 and obtained a photograph of the animal when it climbed out onto a rock on the Maryland side of the river.

The otter may be active any time of the day or night, but tends to be more nocturnal than diurnal. Even though it may be common, it is seldom seen by the casual observer because it is shy and spends much of its time in water. These animals are powerful and graceful swimmers and dive with ease and agility. When swimming on the surface it holds its head high out of the water and both the forelegs and hind limbs are directed backward, progression being made primarily by twisting and moving the body and tail. The otter can reach a speed of 6 or 7 miles an hour on the surface, and nearly as great a speed when submerged.

The otter inhabits a well hidden den along the bank of the stream or river in which it lives. According to Liers (1951, p. 4) these animals seldom dig their own dens, but utilize abandoned beaver lodges or wood-chuck or muskrat burrows, enlarging them to suit their needs. Often these dens are simply short tunnels, but sometimes they may be extensive and complicated. The main entrance is always under water. In marshes, the otter may prepare a nest from dry marsh grasses.

Nothing has been published concerning the breeding habits of otters in Maryland. Liers (1951, p. 4) studied them in Minnesota under semiwild conditions and reports that otters breed there in winter and early spring. He found the gestation period to vary from 9 months 18 days to 12 months 15 days. Only one litter is produced a year, comprising generally two to four young. The male is allowed to rejoin the family group after the young have left the nest, and he assists the female in teaching them to swim and hunt for food.

The otter eats a variety of foods, but is primarily carnivorous, consuming crayfish, frogs, turtles, larvae of aquatic insects, angleworms, and fish (Liers, 1951, p. 1). Jackson (1961, p. 388) says that the otter rarely eats muskrat, young beaver, or duck, and that the parts of land vertebrates occasionally found among its remains probably were eaten as carrion. On Assateague Island the otters appeared to be feeding largely on jumping mullet (*Mugil cephalus*).

Otter fur is currently commanding good prices on the market, being durable, soft, and dense. During the 1965–66 trapping season, 495 wild otters were trapped in Maryland for the fur market (U.S. Fish and

Wildlife Service, Fur Catch in the United States, 1966, Wildlife Leaflet 478).

Specimens examined.—Montgomery County: Glen Echo, 1. *District of Columbia*: 3.

Other records and reports.—Calvert County: Chesapeake Bay, near Stoakley (LeCompte, 1937: 15). *Garrett County*: Deep Creek Lake (Browning, 1928, p. 213). *Harford County*: Edgewood Arsenal area (personal observation). *Montgomery County*: Great Falls (identified from photograph taken by L. G. Henbest, February 1964). *Washington County*: near Leitersburg (Washington, D.C., Herald, 7 January 1909). *Worcester County*: Assateague Island (personal observation).

Family FELIDAE (cats)

BOBCAT

Lynx rufus rufus (Schreber)

Felis rufa Schreber, Die Säugthiere . . . , Thiel 3, Heft 95, pl. 109b, 1777.

Type locality.—New York.

General distribution.—In the eastern United States, this race formerly occurred from central New England south to northern Georgia, and west into the Dakotas, Iowa, Kansas, and Oklahoma. It is now absent or rare in the Coastal Plain in the southern portion of its range except in Virginia's Dismal Swamp.

Distribution in Maryland.—Formerly statewide in distribution, but now confined primarily to the Allegheny Mountain and Ridge and Valley sections. It has been entirely exterminated in the Eastern Shore section and is only rarely encountered in the Western Shore and Piedmont sections.

This species is uncommon enough in Maryland to produce local newspaper accounts when one is taken.

Distinguishing characteristics.—Teeth 3/3, 1/1, 2/2, 1/1, = 28; general appearance catlike, but considerably larger than a domestic cat, averaging about twice as much in size and weight; body short; ears prominent and with small conspicuous tufts on the tips; eyes large and with eliptical pupils; tail very short, less than a fourth of the total length of the animal; pelage fairly long and loose; coloration of upperparts grayish to brownish, darker along the midline, and spotted and blotched throughout; abdomen and inner sides of legs white, prominently marked with black spots; tail always tipped with black.

The only Maryland mammal with which the bobcat may be confused is the domestic cat, from which it is readily distinguished by its larger size and short black-tipped tail.

Measurements.—No external measurements are available for Maryland or District of Columbia specimens in the National collections.

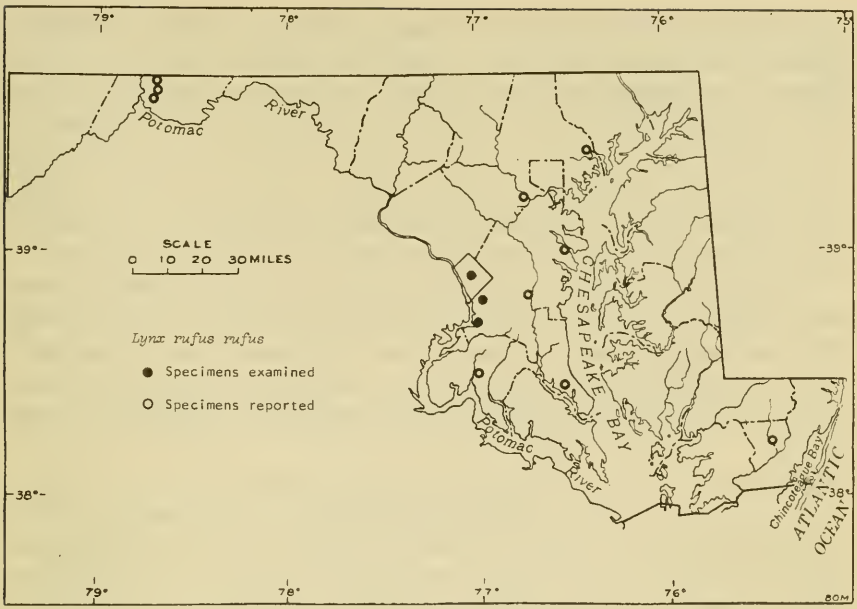

FIGURE 54.—Distribution of *Lynx rufus rufus*.

Kellogg (1937, p. 457) gives external measurements of 11 adult males from West Virginia as follows: Total length 870 (787–935); tail 146 (133–165); hind foot 171 (162–195). According to Jackson (1961, p. 402) the male bobcat averages about 10 percent longer than the female and weighs about 30 percent more.

A female from near Fort Washington, Prince Georges County, has the following cranial measurements: Greatest length 128.0; zygomatic breadth 83.7; interorbital breadth 23.2; maxillary toothrow 40.4.

Habitat and habits.—Bobcats prefer wild heavily wooded or brushy areas, particularly in rocky habitats and swamps. In Maryland the animal is still fairly numerous in the wilder areas of the Allegheny Mountain and Ridge and Valley sections, but is very scarce in the rest of the State. No specimens have been taken in the Eastern Shore section for many years, and presumably the animal is extirpated there. According to Mansueti (1950, p. 21) the species has been ruthlessly exterminated in Maryland as "vermin," and is everywhere much scarcer than in the past.

Mansueti (1950, pp. 22–23) has gathered together a number of bobcat records in Maryland. He says that Meshach Browning is reported to have killed scores of bobcats in the early 19th century, and that they were an everyday occurrence in Garrett County then. Marye (1945) says that a generation ago bobcats were destructive to sheep near the Falls of the Patapasco River, and that in his time they were

occasionally killed in Baltimore County. He reports that in the 1920's he saw a large bobcat in Day's woods, between the Great and Little Falls of the Gunpowder River. He also cites some notes relative to the bobcat on the Eastern Shore and says that about 2 decades ago (also in the 1920's), a wild animal of the cat family was treed by dogs on the borders of the Nassawango Swamp, near Nassawango Bridge in Worcester County. The animal escaped and Marye doubts that any domestic cat could have done so under the circumstances imposed.

Mansueti (1950, p. 22) quotes an article from the Baltimore Evening Sun (18 February 1948) entitled "Bobcats Still Here," which says that Thomas Leary, hunter of Beans Cover, Allegany County, trapped a bobcat in 1948 on Evitts Mountain in Allegany County and the newspaper published a photograph of the animal, thus substantiating the capture.

Mansueti (1950, p. 23) says that John Hamlet, formerly with the U.S. Fish and Wildlife Service, told him that a few years ago (1945 or 1946) a bobcat was known to be roaming the Cypress Swamp region of Calvert County, and Watson Perrygo of the Division of Mammals, U.S. National Museum, tells me that bobcats are presently residing in wild areas on his property near Port Tobacco in Charles County.

Several interesting specimens of bobcats from Maryland and the District of Columbia are in the collections of the U.S. National Museum. One of these, a young female, was shot along with five others in a swamp near Oxon Hill, Prince Georges County, in 1941 when the swamp was being razed for a housing development. Another (an old female) was found dead in December 1958 on the curb of a downtown Washington Street, not far from Rock Creek Park. The animal was not examined for bullet wounds but probably was shot in the mountains west of Washington and then dumped from an auto onto the Washington Street, although it is remotely possible that it had wandered naturally into downtown Washington via Rock Creek Park. Bailey (1923, p. 121) lists several bobcat records from nearby Virginia.

The Maryland Conservationist (27(1), pp. 9, 28, Spring 1950) records the capture of a particularly large bobcat in Maryland. On Labor Day of 1949, Frank Wigfield killed the animal on Iron Mountain, about 5 miles east of Cumberland, Allegany County. It weighed 43 pounds and measured 53 inches from tip to tip.

The bobcat is shy and retiring, and primarily solitary in its habits. It is almost entirely nocturnal and is seldom abroad in daylight. Generally, it seeks shelter under shrubs or in rock crevices, but sometimes it dens in hollows trees, stumps, or logs. The den is lined with grasses, leaves, moss, and other vegetation, which are scraped and scratched into a nest.

Mating in this species occurs in February or March; the gestation period is about 50 days, and between one and four kittens are born, usually in April. At birth the young are blind; the eyes open after about 9 or 10 days. Although weaned when 60 to 70 days old, the young continue with the mother until autumn or sometimes late winter.

The food of the bobcat is entirely animal in nature, and consists to a large extent of rabbits as well as squirrels, mice, muskrats, and various kinds of birds. Bobcats often feed on deer; fawns are especially vulnerable prey, and no doubt deer carrion is often consumed. Domestic livestock, mainly calves and sheep but also occasionally poultry, are also eaten.

Mansueti (1950, p. 23) says that the bobcat is undoubtedly vanishing in Maryland, but its wary and secretive habits will insure its permanence in some of the more isolated portions of the State.

Specimens examined.—Prince Georges County: Fort Washington, near, 1; Oxon Hill, 1. *District of Columbia:* 1.

Other records and reports.—Anne Arundel County: Annapolis, 3 miles NW near Severn River (John C. Lingebach, in verbis). *Allegany County:* Evitts Mountain (Mansueti, 1950: 22); Iron Mountain (Md. Conservationist, 27(1), pp. 9, 28, Spring 1950). *Baltimore County:* Day's Woods between the Great and Little Falls of the Gunpowder River (Mansueti, 1950, p. 22). *Calvert County:* Cypress Swamp along Battle Creek (Mansueti, 1950, p. 23). *Charles County:* near Port Tobacco (W. M. Perrygo, in verbis). *Howard County:* Falls of the Patapsco River (Mansueti, 1950, p. 22). *Prince Georges County:* Patuxent River, near Upper Marlboro (Bailey, 1923, p. 121). *Worcester County:* Nassawango Swamp, near Nassawango Bridge (Mansueti, 1950, p. 22).

Order ARTIODACTYLA (even-toed hoofed mammals)

Family CERVIDAE (deer)

SIKA DEER

Cervus nippon Temminck

Cervus nippon Temminck, Coup d'oeil sur la faune des iles de la Sonde et de l'empire du Japon, xxii, 1838.

Type locality.—Japan.

General distribution.—Native to Japan, eastern China, Korea, and Manchuria. Introduced into England, New Zealand, Denmark, France, Austria, Russia, and the United States.

Distribution in Maryland.—James Island, Taylors Island, and adjacent mainland in Dorchester County, and Assateague Island Worcester County.

Distinguishing characteristics.—Teeth 0/3, 1/1, 3/3, 3/3, = 34; size small; coloration brownish olive or reddish olive with the middorsal area somewhat darker and forming an indistinct dark line from the forehead to the rump; underparts somewhat lighter; dorsum, particularly posteriorly, faintly speckled with indistinct white blotches in both young and adults, the white blotches being more noticeable in summer than winter; prominent white rump patch with semierectile hairs; antlers in male narrow, seldom having over three points and standing erect over head.

This species is distinguishable from the white-tailed deer by a number of easily recognizable characters. It is considerably smaller, averaging a third less in weight; has speckled pelage in young and old of both sexes; has narrower antlers that stand erect above the head, rather than curving forward over head; and possesses a small canine tooth in both sides of upper jaw.

Measurements.—No external measurements are available for any of the Maryland specimens. The species ranges in shoulder height from 32 to 43 inches (Tate, 1947, pp. 341–342).

Cranial measurements of an adult male from James Island, Dorchester County, are: Greatest length 231; zygomatic breadth 97.1; interorbital breadth 69.3; maxillary toothrow 68.6. Cranial measurements for two adult females from James Island are as follows: Greatest length 220, 224, zygomatic breadth 91.3, 93.4; interorbital breadth 53.0, 60.0; maxillary toothrow 62.5, 65.9.

Habitat and habits.—In its natural range, this species prefers hilly regions with mixed large-leafed forests. It does best in areas which are not subject to heavy snowfall (Flerov, 1952, p. 128).

In Maryland, it has been introduced on Assateague Island, and on James Island, from which it has spread to neighboring Taylors Island and the adjacent Dorchester County mainland. According to Flyger (1960a), four or five sika deer were released on James Island about 1916 by Clemment Henry, who had kept them in an enclosure near Cambridge for an unknown period before releasing them on the island. They multiplied on James Island and spread to nearby Taylors Island, and eventually to the mainland. Flyger and Warren (1958) estimated that in the fall of 1957, 270 sika deer inhabited James Island. Regarding their introduction to Assateague Island, Flyger (1960a) says that Charles Law of Berlin, Md., stated that he purchased five sika deer (two males and three females) from a man in Cambridge in 1920. These deer were held in an enclosure near Berlin for several years, during which time three young were born and one of the original males died. Dr. Law sold these deer to a man who in turn released them on Assateague Island where they have prospered and grown into a herd

of over a thousand animals (Flyger, 1964, p. 213). Most of these, however, are located in the southern portion of the island in Virginia.

Sika deer can be hunted in Maryland during the regular deer hunting season, and nearly every year a few have been taken in Dorchester County. However, these deer are wilder and more timid than native white-tailed deer, and are more difficult to stalk. Because they are primarily nocturnal in habits many local people are even unaware of their existence in their neighborhood.

The sika deer has been introduced into various European countries, some of which are not pleased with the species since it is too secretive and wild to be a satisfactory game animal, and has a propensity for peeling bark from trees and competing with other species of deer for food (Flyger, 1959, p. 24). Whether it is a potential boon or threat to sportsmen in Maryland is still uncertain.

Little is known of the biology of this species in Maryland. In the Soviet Union where the animal has been widely introduced, Flerov (1952, pp. 128–129) reports that they are gregarious and that during certain periods their herds consist of many dozens of animals. Rutting begins in September and lasts for 1½ to 2 months. Rutting takes a very stormy course and is accompanied by roaring and terrific battles. After the rut, the males gather together in herds and remain apart from the females during the entire winter. Females with 2- or 3-year-old young also gather in separate groups just prior to winter. Calving occurs toward the end of May or June, generally one fawn, but occasionally twins, being produced.

These deer swim readily and sometimes will cross large bodies of salt water. Their food in Maryland is probably similar to that of the white-tailed deer, and it is feared that in areas where the sika deer becomes well established the native white-tailed species will not be able to compete for the available food supply.

Specimens examined.—Dorchester County: James Island, 8.

Remarks.—Presnall (1958, pp. 48–49) listed sika deer as occurring on Assateague Island, but incorrectly identified the deer from Dorchester County as hog deer (*Axis porcinus*). As pointed out by Flyger (1960a), not only are the Dorchester County animals *Cervus nippon*, but very probably they derive from the same stock as the Assateague Island populations.

In addition to Sika deer, Maryland supports small populations of introduced fallow deer (*Dama dama*). Presnall (1958, p. 48) says that a few animals remain from introductions in Worcester County (Mills Island in Chincoteague Bay) between 1920 and 1930, and in Talbot County between 1935 and 1945. Fallow deer are native to the Mediterranean region of southern Europe and western Asia, but have been widely introduced in northern Europe and the United States, where

colonies exist in Kentucky, Tennessee, Virginia, and elsewhere. This deer is about the size of a Maryland white-tailed deer, but with large palmate antlers which are directed upward. In summer pelage, the coloration is fawn, with numerous white spots; in winter, a uniform grayish (although melanism and albinism are not infrequent). Miller (1912, pp. 971–972) gives external measurements of a European adult male of this species as: Head and body length 1540; tail 190; hind foot (with hoof) 435; ear from crown 165.

WHITE-TAILED DEER

Odocoileus virginianus borealis Miller

Odocoileus americanus borealis Miller, Bull. New York State Mus. Nat. Hist., 8: 83, 21 November 1900.

Type locality.—Bucksport, Hancock County, Maine.

General distribution.—"Western Ontario, east across southern Quebec, New Brunswick, and Nova Scotia; and from near James Bay (Newport, Abitibi River), Gaspé Peninsula, and Anticosti Island south to southern Maryland, southern Pennsylvania, Ohio, Indiana, and Illinois. Southern boundaries fixed at Potomac and Ohio rivers and the western limits at the Mississippi and Red Rivers." (Kellogg, 1956, p. 40).

Distribution in Maryland.—At one time the white-tailed deer was nearly extirpated in Maryland. Today it is common in all sections of the State, and is found in the wilder areas of every county.

Distinguishing characteristics.—Size large, larger than sika deer; antlers heavy, and main beam directed forward, bearing the several tines behind; upper parts of body colored reddish brown in summer and grayish in winter, unspotted except in juveniles; underparts and underside of tail white; juvenile animals are reddish yellow and spotted with white.

Measurement.—Kellogg (1956, p. 40) gives external measurements of the largest male of this subspecies that he examined as: Total length 2400; tail 365; hind foot 538; height at shoulder 1041. Two adult males from Cumberland, Allegany County, have the following cranial measurements: Condylobasal length ——, 261.8; width of orbit at frontojugal suture 129.7, 120.9; least interorbital breadth 74.2; length of maxillary toothrow 71.8, 72.5. Females average smaller than males in size.

Flyger (1958, p. 8) says that the average weight of 47 adult male deer from western Maryland was 127.5 pounds, and 17 from Worcester County averaged 125.4 pounds, whereas 6 from the Aberdeen Proving Grounds in Harford County averaged only 104.2 pounds. Wherever the deer population becomes so great that a scarcity of food results, the size and weight of the deer in that area become markedly reduced.

This was the case with the Aberdeen herd, where at the time of Flyger's study deer were over abundant.

Habitat and habits.—Deer are essentially animals of the "edges," preferring burned-over areas and second-growth timber. They are much less common in heavily forested sections because the dense foliage discourages the growth of low forage on which the deer feed. Since much of Maryland today consists of edge habitat, deer are probably even more abundant in the State than they were before the coming of the white man when most of the area was heavily wooded.

Even though much of Maryland was heavily forested in precolonial and colonial days, white-tailed deer were apparently numerous and supplied a good source of food for early settlers. According to Mansueti (1950, p. 13) there are countless references to the abundance of deer in early letters and accounts of conditions of the 17th, 18th, and 19th centuries.

Although deer originally occurred in every Maryland county, the species was almost exterminated from about 1900 until the early 1930's. This was due apparently to high hunting pressure and other factors. For example, Browning (1928) estimated that he killed between 1,800 and 2,000 deer during his hunting career in western Maryland, and that by 1839 the deer in Garrett and Allegany counties were beginning to become scarce. Other factors that were responsible for the decline in the deer herds in Maryland include wild dog packs and forest fires, both of which are known to have killed many individuals throughout the State.

The population increase in recent years has resulted from stocking and intelligent conservation, as well as from the increased "edge" habitat in many areas of the State. Today, the white-tailed deer occurs in all sections of Maryland, and in some places is overabundant. Such an area is the Aberdeen Proving Grounds in Hartford County, where according to Flyger (1958, p. 3) counting 100 or 200 deer in a single morning's observation is not at all unusual, and where a distinct browse line is evident in the woods. At the Proving Grounds, also, there have been several instances of mass die-off in recent years, an indication of overpopulation in a particular area. Flyger found that the deer herd in Cecil County, on the other hand, is still rapidly growing and the range there is more understocked than in any other part of the State.

The Maryland Conservationist (40(1), p. 15, Jan.–Feb., 1963) lists the total deer kill in various Maryland counties for the 1962 season as follows: Garrett 577, Allegany 699, Washington 344, Frederick 214, Carroll 114, Howard 12, Montgomery 2, Anne Arundel 5 Calvert 93, Prince Georges 12, Charles 208, St. Marys 33, Baltimore 95, Cecil

351, Harford 70, Kent 619, Queen Annes 124, Caroline 106, Talbot 180, Dorchester 696, Somerset 192, Wicomico 161, Worcester 377. In addition to the above, 418 deer were killed at Aberdeen Proving Grounds during the season. The Fish and Wildlife Service reports (Big Game Inventory for 1967, Wildlife Leaflet 481, September 1968) an estimated total of 75,000 deer in the State for 1967.

White-tailed deer are primarily nocturnal, but are often abroad during daylight hours. With regard to feeding habits of this species in Maryland and the availability of food within the State, Bitely (1963, pp. 8–9) says:

> Deer require a varied diet and if you've ever watched them feed, they'll nibble here and there, take a twig of witch hazel, then red maple, some huckleberry and for dessert some greenbriar. . . . Whenever possible, they prefer browse, such as greenbriar, maple leaf viburnum, blueberry, sassafras, black oak, red maple and blackberry. After several winters of heavy browsing these species begin to disappear and the deer are forced to shift to less nutritious food.
>
> During the winter a deer requires from 6 to 8 pounds of dry browse each day for body and heat maintenance. If the quality and quantity of food is insufficient they become victims of diseases (especially pneumonia) and parasites. Very few deer in this section of the United States ever actually starve to death; disease usually gets them first.

He says that surveys conducted in 1962 in western Maryland indicated heavy browsing pressure on the preferred foods. For instance, of the twigs within reach and available to deer, the following percentages had been browsed: Maple-leaved viburnum, 53.9; blackberry, 43.8; blueberry, 59.0; black birch, 38.8; black cherry, 14.3; dogwood 33.9; greenbriar, 77.6; hazelnut, 24.1; red maple, 25.9; black oak, 44.4; sassafras, 54.8. In the western three counties, an average of 29 percent of the annual growth was browsed each year. By contrast, on the Eastern Shore, only an average of 6.1 percent was taken. The statewide survey disclosed that a total of 58 species of woody plants had been browsed throughout Maryland.

The following life history notes on the white-tailed deer are extracted primarily from Severinghaus and Cheatum (1956, pp. 57–186).

It is generally agreed that social organization in this species is limited to the family group, which usually consists of an older doe with her fawns, sometimes including those of the previous year. Leadership of the group appears to rest with the old doe. The occasional antlered buck that may be seen with the family group is usually the yearling offspring of the old doe. In the Northern States, the breeding season begins in November and the young are born in May or June. Antlers begin to appear on the bucks in the summer. They grow from a pedicle of the frontal bone and are covered with a true skin (the velvet) during their growth. Antler growth is rapid,

usually full size being achieved within 4 months or less. During the period of antler growth, the buck is very careful of the sensitive appendages, but after full size is reached, the velvet is scraped away, and the polished antlers are used by the bucks in battles for mates. The necks of the bucks also swell considerably during the mating season. After the mating season the antlers are shed, usually in January or early February in Northern States, then the cycle continues.

Gestation period in this species varies from 189 and 222 days, with the average being about 201 days. The usual number of young, for older does, is two, occasionally three. A young doe, however, usually gives birth to only a single offspring. The fawns are spotted, and remain in thickets where they blend perfectly with the dappled shadows of the foliage. Both bucks and does generally achieve sexual maturity at 18 months of age, although well-nourished doe fawns, at least in northern areas, may breed at 6 to 8 months of age.

Specimens examined.—Allegany County: Cumberland, 3.

Other records and reports.—White-tailed deer have been reported from every county in Maryland.

Remarks.—The subspecies of white-tailed deer that originally inhabited Maryland was *Odocoileus v. borealis*. By the turn of the present century, however, the species was nearly extinct in Maryland, as well as in most other eastern States. Widespread transplanting of deer from areas in which they were still abundant reestablished eastern herds. Deer from many areas, and representing a number of subspecies, were brought into Maryland, and consequently today it is impossible to assign the State's deer to any specific subspecies. According to Hosley (1956, p. 228): "One effect of the widespread transplanting of Lake States deer into the south and east and of other similar moves has been to mix up thoroughly the races existing in most of the deer range."

MARINE MAMMALS OF MARYLAND

The following list of marine mammals comprises only those that have stranded on Maryland beaches, or have been observed in waters off the Maryland coast and in Chesapeake Bay. The list does not include all the marine mammals that may occur in Maryland waters, and many additional species will eventually be discovered. Some of these unrecorded species have stranded on beaches to the north and south of Maryland and must also pass through Maryland waters. Only those, however, which have actually been reported from the State will be discussed in any detail.

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Order PINNIPEDIA (pinnipeds)

Family PHOCIDAE (earless seals)

HARBOR SEAL

Phoca vitulina concolor De Kay

Phoca concolor De Kay, Zoology of New York . . . , Vol. 1, pt. 1 (Mammalia), p. 53, 1842.

Type locality.—Long Island Sound, near Sands Point, Nassau County, N.Y.

General distribution.—Along the Atlantic coast of North America from Ellesmere Island to South Carolina, but is rare in the northern and southern portion of this range.

Description.—A small seal that averages in total length about 4 or 5 feet and weighs 75 to 150 pounds. The pelage is coarse and varies from yellowish gray, spotted with dark brown to almost black, spotted with yellowish. The spotted pelage and small size are distinctive characters of this species.

Maryland records.—Harbor seals in Maryland waters are stragglers; they are not indigenous to the State. Mansueti (1950, pp. 28–29; 1955, p. 2) summarizes Maryland records as follows: One specimen taken in a seine in Chesapeake Bay near Elkton in August 1824; one animal feeding around Thomas Pouch Lighthouse, near Annapolis, in March 1894; one animal killed in Tangier Sound on 8 July 1898; one specimen sighted on 14 September 1898 on a beach above reach of heavy waves at Ocean City, Worcester County; several animals in Choptank River near Tilghman Island in the early part of February 1925; one specimen seen in Chesapeake Bay at Flag Pond in 1940; one animal sighted at Ocean City, Worcester County, in May 1955.

In addition, there is a fragmentary skin and partial skeleton of a harbor seal in the National collections; the specimen was found on the beach at Assateague Island, 3 miles south of Ocean City, Worcester County, on 12 May 1959.

HOODED SEAL

Cystophora cristata (Erxleben)

[*Phoca*] *cristata* Erxleben, Systema regni animalis . . . , 1:590, 1777.

Type locality.—Southern Greenland or Newfoundland.

General distribution.—North Atlantic coast from Greenland to Labrador. Newfoundland, Nova Scotia, and Gulf of St. Lawrence, south as an accidental to Florida.

Description.—A large seal, with males ranging up to 10 feet in total length and weighing up to 850 pounds. Females are smaller, averaging about 8 feet in length and weighing up to 400 pounds. Coloration slate-

gray to blackish dorsally, with sides paler and spotted with white. Males have a bladderlike protuberence on the nose which they can inflate in times of anger or danger.

Maryland records.—One recorded in 1865 as taken near Cambridge, Dorchester County, on an arm of the Chesapeake Bay, 18 miles from salt water (Cope, 1865, p. 273); one animal killed at Worton Point, near Chestertown, Kent County, about 1860 (Mansueti, 1950, p. 31).

It is possible that the seal from Tangier Sound previously listed as *Phoca vitulina concolor* may have been a hooded seal rather than a harbor seal. The Baltimore Sun of 9 July 1898, which reported the killing of the animal on 8 July 1898, said that it measured almost 6½ feet in length. If this measurement was accurate, the animal would fall within the size range of the hooded seal rather than the harbor seal.

Order CETACEA (cetaceans)

The order Cetacea is divisible into two distinct suborders distinguished primarily by the presence of teeth, or baleen in the mouth. Those that are toothed are classified as:

Suborder ODONTOCETI (toothed whales)

Toothed whales may have teeth in the lower jaws only, or in both upper and lower jaws. In some forms more than 100 teeth are present, while in others the teeth may be reduced to 2. Whales of this suborder never possess baleen.

Family ZIPHIIDAE (beaked whales)

GOOSE-BEAKED WHALE

Ziphius cavirostris G. Cuvier

Ziphius cavirostris G. Cuvier, Recherches sur les ossemens fossiles . . . , ed. 2, 5 : 352, 1823.

Type locality.—Near Fos, Bouches-du-Rhone, France.

General distribution.—In the western North Atlantic, reported from Newport, Rhode Island, south to St. Simon Island, Ga.

Description.—A medium-sized whale, ranging up to 28 feet in length. The body is thickset and has a strongly marked median keel extending from the dorsal fin to the tail. The color pattern is extremely variable; the back is usually a purplish black and the underparts white. Males have a single tooth projecting an inch or more beyond the gum at the end of each lower jaw.

Maryland records.—On 5 September 1959, a whale of this species was sighted alive north of Fenwick Island, Del. It stranded that night at

Maryland Beach, Worcester County. This is the only Maryland record, although specimens have stranded at other localities to the north and south of the State.

Family PHYSETERIDAE (sperm whales)

SPERM WHALE

Physeter catodon Linnaeus

[*Physeter*] *catodon* Linnaeus, Syst. Nat., ed. 10, 1: 76, 1758.

Type locality.—Kairston, Orkney Islands, Scotland (by restriction, Thomas, Proc. Zool. Soc. London, p. 157, 22 March 1911).

General distribution.—In western North Atlantic from Iceland and Davis Straits, south to Gulf of Mexico, West Indies, Lesser Antilles, and coast of Venezuela.

Description.—This species is the largest of the toothed whales, males sometimes reaching a length of 60 feet or more. Females are considerably smaller, generally under 40 feet in length. In coloration this whale is a uniform gray or dark bluish gray. The narrow lower jaw contains 20 to 30 heavy teeth. Usually no teeth are visible in the upper jaws. There is no dorsal fin.

Maryland records.—Only one sperm whale is known to have stranded on a Maryland beach. It came ashore at Green Run Inlet (now closed) just north of the Maryland-Virginia boundary on Assateague Island in December 1891. This specimen is preserved as a skeleton in the U.S. National Museum.

At times, sperm whales are numerous off Ocean City. They attract the attention of passing boats by their habit of raising their flukes clear of the water when sounding.

PIGMY SPERM WHALE

Kogia breviceps (Blainville)

Physeter breviceps Blainville, Ann. d'Anat. et de Physiol., 2: 337, 1833.

Type locality.—Region of Cape of Good Hope, Republic of South Africa.

General distribution.—In western North Atlantic recorded from Halifax Harbor, Nova Scotia, south to Jupiter Inlet, Florida. This is a pelagic species that is seldom found stranded on beaches.

Description.—A small edition of its larger relative the sperm whale, the pigmy sperm whale ranges in length from 9 to 13 feet. In coloration it is black above, white beneath. There are usually 14 or 15 small needlelike teeth in each lower jaw; no teeth visible in upper jaws. This species, unlike the large sperm whale, possesses a small dorsal fin.

Maryland records.—The pygmy sperm whale is known from Maryland by a live specimen that came ashore at Ocean City, Worcester County, in August 1959. Vacationers at the beach repeatedly tried to push the small whale back to sea. Eventually, during a high tide the animal worked its way into deeper water where it struggled away. The stranding of this whale is discussed in detail by Manville and Shanahan (1961, pp. 269–270).

Family DELPHINIDAE (porpoises and dolphins)

ATLANTIC DOLPHIN

Delphinus delphis Linnaeus

[*Delphinus*] *delphis* Linnaeus, Systema naturae, ed. 10, 1: 77, 1758.

Type locality.—European seas.

General distribution.—In western North Atlantic recorded from Iceland and Woods Hole, Massachusetts, south to Bahama Islands and Jamaica.

Description.—This is a small Cetacean, reaching a length of about 8 feet. The animal possesses a slender "beak" about 6 inches long, which is sharply marked off from the sloping forehead by a deep V-shaped groove. The mouth contains many sharp pointed teeth that interlock perfectly and are adapted for catching and holding the fish upon which the dolphin preys. In coloration, this species is blackish dorsally, including the dorsal surfaces of the flukes and pectoral apendages. The sides shade in coloration to a grayish green, mixed with eliptical bands of whitish on the flanks. The abdomen is white and there is a whitish band over the forehead with a narrow black band in the center that connects the black eye rings. Often there is a black band from the snout to the leading edge of the pectoral fin.

Marlyand records.—No records of strandings of this species are available from Maryland, but Charles O. Handley, Jr., says (unpublished manuscript): "In September 1959, Mike Freeman of Washington, D.C., told me of having seen two kinds of porpoises in unusual abundance off Ocean City, Md., and running the Ocean City Inlet into Sinepuxent Bay. His descriptions indicated *Tursiops truncatus* and *Delphinus delphis*."

This cetacean is probably one of the most abundant in Maryland waters, but it prefers deeper waters off shore, and hence is less likely to strand than several other less numerous species.

BOTTLE-NOSED PORPOISE

Tursiops truncatus (Montague)

Delphinus truncatus Montague, Mem. Wermerian Nat. Hist. Soc., 3: 75, 1821.

Type locality.—Totness, Devonshire, England.

General distribution.—In the western North Atlantic recorded from Massachusetts south to Florida.

Description.—Adults of this species reach a length of 11 or 12 feet, and may be recognized by the purplish lead-gray coloration of the upper parts, the short beak, seldom more than 3 inches long, and the lower jaw, which is slightly longer than the upper. There are 20 to 26 teeth on each side in both jaws of the mouth.

Maryland records.—True (1890, p. 197) says that he has been informed that this species ascends the Potomac River as far as Glymont, a fishing station on the Maryland shore about 18 miles below Washington, D.C.

On 27 and 28 July 1884, a porpoise, presumed to be of this species, was observed in the Potomac River above the Aqueduct Bridge in Washington, D.C. It was chased by boats and shot at repeatedly, but not captured. The species has been seen at various times near Alexandria (unsigned note in The Pastime, 3(2), p. 14, August 1884).

In the Chesapeake Bay, *Tursiops* has been reported as far up as Havre de Grace, Harford County (Maryland Tidewater News, 8, p. 40, 1952).

Specimens in the National collections are from the following Maryland localities: Point Lookout, St. Mary's County; Queenstown Creek, Queen Annes County; and Scientist's Cliffs, Calvert County.

In addition, bottle-nosed porpoises are often seen off Ocean City, Worcester County, and swimming in the Ocean City Inlet into Sinepuxent Bay. This is probably the most abundant marine mammal in Maryland waters.

Suborder MYSTICETI (baleen whales)

Whales of this suborder do not possess teeth. Instead, they are equipped with whalebone, or baleen, which hangs down in the mouth from either side of the upper jaws in long strips, with hairlike bristles on the inner edges. The apparatus thus formed serves as a strainer. In feeding, the baleen whales swim open-mouthed through swarms of plankton; then closing the mouth, they press the tongue against the baleen plates, squeezing out the water and leaving the plankton inside the mouth to be swallowed.

Family BALAENOPTERIDAE (fin-backed whales)

LITTLE PIKED WHALE

Balaenoptera acutorostrata Lacépède

Balaenoptera acutorostrata Lacépède, Histoire naturelle des Cétacée . . . , p. 37, 1804.

Type locality.—European seas.

General distribution.—Adults of this species apparently winter in tropical or warm temperate waters, and summer in cold temperate and boreal waters. Young animals, however, may frequent warm or temperate waters during the summer months. In the western North Atlantic, adults have been reported during the summer from Iceland and Greenland south to New Jersey and the Delaware River. There are records of this species in Florida waters during winter months. (see Schwartz, 1962, pp. 206–209).

Description.—The little piked whale resembles a small fin-backed whale in appearance, but is of somewhat stouter build. Adults reach a length of about 30 feet. There are approximately 50 ventral grooves in the throat region, and the baleen is entirely yellowish white in color. The body is blue-gray on the back and white on the abdomen.

Maryland records.—This species has been recorded from Maryland only once. On 12 July 1959, an immature female stranded at Dares Beach, Calvert County, in Chesapeake Bay. Schwartz (1962) discusses this specimen and its stranding in detail.

FIN-BACKED WHALE

Balaenoptera physalus (Linnaeus)

[*Balaena*] *physalus* Linnaeus, Systema naturae, ed. 10, 1:75, 1758.

Type locality.—Spitzbergen Seas (See Thomas, Proc. Zool. Soc. London, 1911, pt. 1, p. 156, 22 March 1911).

General distribution.—In western North Atlantic, from Iceland and Greenland south to the Gulf of Mexico and Caribbean Sea.

Description.—This is a large baleen whale, the adults measuring between 50 and 65 feet in total length. The coloration is velvety black except for a small ash-colored area at the tip of the lower jaws, a cream-colored chin and throat and occasionally white or piebald underparts. The undersurface of the body in the region of the throat has numerous longitudinal grooves. The dorsal fin is high and triangular, usually with a concave posterior border. The baleen in this species exhibits asymmetry in coloration, the blades on the right side being white for more than a third of the distance from the tip of the snout and the remainder on that side, and all of the left side, being colored a dull blue-gray with streaks of white and yellow. This whale is known as the greyhound of the ocean because of its slender build and great speed in swimming.

Maryland records.—The type specimen of *Sibbaldius tectirostris* Cope (a species now regarded as a synonym of *Balaenoptera physalus*) washed ashore on the Maryland coast near Sinepuxent Inlet, Worcester County, in the winter 1868–69. The skull of this specimen is now in the U.S. National Museum collections.

There is a report in the Maryland Tidewater News (1953) that a whale 60 feet in length was stranded at Ocean City, Worcester County, in the spring of 1953 which probably was of this species.

Fin-backed whales are more numerous off the Maryland coast than these two stranding records would indicate.

BLUE WHALE

Balaenoptera musculus (Linnaeus)

[*Balaena*] *musculus* Linnaeus, Systema naturae, ed. 10, 1: 76, 1758.

Type locality.—Firth of Forth, Scotland (see Thomas, Proc. Zool. Soc. London, 1911, pt. 1, p. 156, 22 March 1911).

General distribution.—In the western North Atlantic, from Iceland and Greenland south to Panama.

Description.—This is the largest animal that ever lived, either on land or in water. Adults sometimes reach lengths in excess of 100 feet, the largest specimens usually being females. The color of this species is slate blue over the whole body with the exception of the tip and undersurface of the flippers, where pigmentation is absent. The blue coloration may be modified by a pale mottling that is sometimes diffused and sometimes concentrated in patches in different parts of the body. There are between 80 and 100 ventral throat grooves and the baleen in the mouth is jet black.

Maryland records.—This species is known from Maryland by a single specimen that grounded near Crisfield, Somerset County, in the summer of 1876. The skeleton of this juvenile individual, identified by G. S. Miller, Jr., is now in the museum of the Natural History Society of Maryland in Baltimore.

Remarks on Maryland Marine Mammals

The above list is composed only of species that have stranded or been observed off the Maryland coast. Many other species undoubtedly pass through Maryland waters and will someday be recorded for the State. Some, such as the short-finned blackfish (*Globicephala macrorhyncha*) and the Atlantic blackfish (*Globicephala melaena*), have stranded on beaches only a few miles south of the Maryland State line. The following is a list of species, presently unrecorded for the State, which probably occur at some time or other in Maryland waters:

Harp seal, *Phoca groenlandica* Erxleben.
Dense-beaked whale, *Mesoplodon densirostris* (Blainville).
Gulf Stream beaked whale, *Mesoplodon europaeus* (Gervais).
Northern beaked whale, *Mesoplodon mirus* True.
Striped porpoise, *Stenella coeruleoalbus* (Meyen).

Atlantic killer whale, *Grampus Orcinus* (Linnaeus).
Atlantic blackfish, *Globicephala melaena* (Traill).
Short-finned blackfish, *Globicephala macrorhyncha* Gray.
Harbor porpoise, *Phocoena phocoena* (Linnaeus).
Sei whale, *Balaenoptera borealis* Lesson.
Hump-backed whale, *Megaptera novaeangliae* (Borowski).
Right whale, *Eubalaena glacialis* (Borowski).

EXTIRPATED RECENT MAMMALS OF MARYLAND

Mansueti (1950) has discussed in detail the extirpated Recent mammals of the State. He lists six species that at one time occurred within Maryland but have vanished since the coming of the white man. As pointed out by Handley and Patton (1947, p. 78):

> Though it is regretable that man has had a hand in the extinction of these creatures, he is not to be blamed too much, for the ascendency of one species and the extinction of another is a regular process of nature which has been repeated over and over again all down through the ages. Probably man did not have much or anything to do with the disappearance of wild horses, mammoths, mastodons, tapirs, wild pigs, ground sloths and camels which once roamed our lands, but they are gone nevertheless. As surely as a species of animal comes into being, it is destined to eventual extinction, whether by geologic catastrophies such as volcanic eruptions or earthquakes; or by great climatic changes involving vast spreading glaciers or desert wastes, or by the hand of man. Our geologists have given us proof of all this by the fossil record in the rocks.

The six species of extirpated Recent mammals of Maryland discussed by Mansueti (1950) are:

PORCUPINE

Erethizon dorsatum (Linnaeus)

This species apparently never was widely distributed in Maryland, nor was it ever abundant. Mansueti cites records from Allegany County; Blue Ridge Mountains; Frederick-Washington Counties; and Ellicott City, Howard County (all of these prior to 1881). Rhoads (1903, p. 115) cites porcupine records from Fulton and Somerset Counties, Pa., adjacent to Maryland on the north. The Cumberland (Maryland) Sunday Times for 9 August 1964 reported that recently a porcupine was shot on a farm at Rocky Gap, east of Cumberland. A photograph of this animal accompanied the news release. This may represent a valid state record, or the animal may have been brought to Maryland from elsewhere. This same article in the Cumberland Sunday News reports that in 1912 a boy in Frostburg brought some quills

to school from a porcupine he found dead on Mount Savage. It also says that during the fall of 1948 a hunter reported his dogs found a porcupine on Martins Mountain for they returned to him with their noses full of quills. He was not able, however, to locate the porcupine. The foregoing serves to show that there are records and reports of the porcupine in the western part of Maryland right up to the present day. The general consensus of opinion, however, regarding the status of this animal is that it is no longer a native inhibtant of the State.

GRAY WOLF

Canis lupus Linnaeus

The gray wolf originally inhabited the entire State of Maryland. Not only are there documents and publications to show that they were at one time statewide in distribution (see Mansueti, 1950, pp. 25–26), but the early settlers used the name "wolf" to designate many places throughout the State. The Gazeteer of Maryland (Maryland State Planning Comm., and Dept. of Geology, Mines and Water Resources, October 1941, p. 230) lists the following place names in Maryland that give a good idea of where early colonists found wolves: *Allegany County:* Wolf Gap, Wolf Rock; *Baltimore County:* Wolftrap Branch; *Caroline County:* Wolfpit Branch; *Carroll County:* Wolfpit Branch; *Frederick County:* Wolf Rock; *Garrett County:* Wolf Den Run, Wolf Gap, Wolf Swamp; *Somerset County:* Wolf Trap Creek. Mansueti (1950, p. 25) says that they even abounded on Assateague Island in Worcester County.

All evidence seems to indicate that the gray wolf was exterminated in Maryland at a very early date, except for those in more inaccessible parts of western mountains. Here the species probably persisted until late in the 19th century, and perhaps even to the early part of the present century.

MARTEN

Martes americana (Turton)

The marten was exterminated in Maryland as far back as 85 years ago. It apparently was not widespread in distribution, and never abundant. Heavy trapping pressure and destruction of suitable forest habitat appear to account for its demise. It was probably most abundant in the western part of the State, but there are reports from the District of Columbia and perhaps St. Marys County (see Mansueti, 1950, p. 23).

MOUNTAIN LION

Felis concolor Linnaeus

This species at one time occurred throughout the State, wherever there were white-tailed deer, which served as it principal food. The mountain lion was hunted with relentless energy by settlers and at very early date was exterminated from all but the wildest portions of the western part of the State. The date when the last mountain lion was killed in Maryland is not known, but it was probably sometime toward the end of the 19th century. In the 18th century, the species appears to have been abundant in the mountains of Maryland. Meshach Browning (1928) estimated that he killed more than 50 of them during his active period as a hunter in Garrett County from 1790 to 1836. There is no question that today, however, the species is extinct in Maryland despite the fact that from time to time there are reports of them in some of the more remote portions of the State. None of these recent reports of mountain lions in Maryland have ever been verified, and it seems that the species has been extirpated in the entire Eastern United States, with the exception of Florida where a few still persist in the swamps and hammocks in the Everglades.

WAPITI OR ELK

Cervus canadensis (Erxleben)

This species was at one time statewide in distribution. Mansueti (1950, pp. 11–12) lists a number of early references to it, not only from the mountains of the west, but also in the Tidewater. Its former occurrence within the State is attested to by the number of places that bear the name "elk." Thus, there is an Elklick Run in Anne Arundel County, Elklick Run in Garrett County, Elk Mills, Elk Neck, Elk River, and Elkton in Cecil County, Elk Mountain and Elkridge in Washington County, Elkridge in Harford County, Elkridge in Howard County, and Elkridge in Baltimore County. The last of Maryland's wapiti were apparently exterminated long before the middle of the 19th century. McAtee (1918, p. 52) places the date of their extirpation in Virginia as 1844.

BISON

Bison bison (Linnaeus)

According to Mansueti (1950, p. 10) the distribution of bison in Maryland and the District of Columbia must have been above the fall line. The bison thus was an inhabitant of the Piedmont, Ridge and Valley, and Allegheny Mountain sections of the State. When the first settlers arrived, however, the species was already becoming scarce, and

these settlers hastened its demise, exterminating the bison in Maryland by 1775. The Glades Star (publication of the Garrett County Historical Society) for 1943, says that around 1774 one of the Ashbys (early settlers in the Glades of Garrett County) and a neighbor were searching for the neighbor's cows one day in early winter. They followed the tracks of some animals in the light snow until they came to what is now the J. J. Ashby farm, when Ashby saw a bunch of wooly hair on a snag. Following the trail still farther to the hill southeast of the present town of Grellin, they spotted 4 bison. They shot the bulls and the cows escaped westward. These were the last seen in the Glades, and probably the last of Maryland's bison herd.

The former occurrence of the bison is still indicated by such place names as: Buffalo Road (Carroll and Frederick Counties); Buffalo Run, Little Buffalo Run, and Buffalo Marsh (Garrett County).

Mansueti (1950) lists 2 additional species (fisher, *Martes pennanti;* and Canada lynx, *Lynx canadensis*) that may have occurred in Maryland in the past but are not presently a part of the fauna of the State. There is no good evidence, however, that either of these species ever ranged as far south as Maryland.

REFERENCES

Allen, D. L.
1950. The fabulous whistlepig. Sports Afield, 123: 28–29, 78–80. June.

Arner, D.
1949. Western Maryland beaver. Maryland Conservationist, 26: 23–24. Summer.

Audubon, J. J., and J. Bachman.
1851. The viviparous quadrupeds of North America. Vol. 2: 334.

Bailey, J. W.
1946. The mammals of Virginia. Williams Printing Co., Richmond. 416 p. December.

Bailey, V.
1896. List of mammals of the District of Columbia. Proc. Biol. Soc. Washington, 10: 93–101. 28 May.
1923. Mammals of the District of Columbia. Proc. Biol. Soc. Washington, 36: 103–138. 1 May.

Bangs, O.
1896. A review of the squirrels of eastern North America. Proc. Biol. Soc. Washington, 10: 145–167. 28 December.

Barbour, R. W.
1951. The Mammals of Big Black Mountain, Harlan County, Kentucky. Journal of Mammalogy, 32: 100–110. February.

Barkalow, F. S., Jr.
1956. *Sciurus niger cinereus* Linne neotype designation. Proc. Biol. Soc. Washington, 69: 13–20. 21 May.

Bednarik, K. E.
1958. Nutria in the United States with management recommendations for Ohio. Ohio Department of Natural Resources, Division Wildlife, Game Management Publication 165: 1–22. 15 October.

Bee, J. W., and E. R. Hall.
1951. An instance of coyote-dog hybridization. Transactions Kansas Academy of Science, 54: 73–77.

Bitely, R. D.
1963. Maryland whitetails. Maryland Conservationist, 50: 8–10. September–October.

Bole, B. P., Jr., and P. N. Moulthrop.
1942. The Ohio Recent mammal collection in the Cleveland Museum of Natural History. Science Publications Cleveland Museum Natural History, 5: 83–181. 11 September.

Bonwill, A. H., and H. B. Owens.
1939. The return of a native. Bulletin Natural History Society Maryland, 10: 35–45. December.

Bookhout, T. A.
1964. The Allegheny spotted skunk in Maryland. Chesapeake Science, 5: 213–215. Winter.

Braun, E. Lucy.
1950. Deciduous forests of eastern North America. Blackiston Co., Philadelphia, 596 p.

Brayton, A. M.
1882. Report on the Mammalia of Ohio. Report Geological Survey Ohio, 4: 1–185.

Browning, Meshach.
1928. Forty-four years of the life of a hunter. J. B. Lippincott Co., Philadelphia. 400 p.

Bures, J. A.
1948. Mammals of a limited area in Maryland, an ecological study in the Bare Hills–Lake Roland area. Maryland Naturalist, 18: 58–72. Fall.

Burt, W. H.
1946. The mammals of Michigan. University of Michigan Press, Ann Arbor. 288 p.

Caslick, James W.
1956. Color phases of the roof rat, *Rattus rattus*. Journal of Mammalogy, 37: 255–257. May.

Christian, J. J.
1956. The natural history of a summer aggregation of the big brown bat, *Eptesicus fuscus fuscus*. American Midland Naturalist, 55: 66–95. January.

Churcher, C. S.
1959. The specific status of the New World red fox. Journal of Mammalogy, 40: 513–520. 20 November.

Cohen, E.
1942. Myotis keeni septentrionalis (Trouessart) in Maryland. Journal of Mammalogy, 23: 96. February.
1944. A new homing record for the large brown bat. Maryland Naturalist, 14: 65–67. July.

Conaway, C. H.
1952. Life history of the water shrew (*Sorex palustris navigator*) American Midland Naturalist, 48: 219–248. July.

Conner, P. F.
1959. The bog lemming *Synaptomys cooperi* in southern New Jersey. Publs. Mus. Michigan State University, Biol. Series 1: 161–248. 24 July.

Cooper, J. E.
1953. An abnormally colored mole from Maryland. Maryland Naturalist, 23: 78–79.

Cope, E. D.
1865. (Hooded seals in the Chesapeake Bay). Proc. Biol. Academy of Science, Philadelphia, 273.

Coues, E.
1877. Fur bearing animals: A monograph of North American Mustelidae. Department of the Interior, U.S. Geological Survey of the Territories Misc. Publ. 8. 348 p.

Davis, D. E., and W. T. Fales.
1949. The distribution of rats in Baltimore, Maryland. American Journal of Hygiene, Baltimore, 49: 247–254. May.
1950. The rat population of Baltimore, 1949. American Journal of Hygiene, Baltimore, 52: 143–146. September.

Davis, W. H.
1957. A new subspecies of the eastern pipistrelle from Florida. Proc. Biol. Soc. Washington, 70: 213–215. 31 December.
1959. Taxonomy of the eastern pipistrel. Journal of Mammalogy, 40: 521–531. November.

Davis, W. H., and R. E. Mumford.
1962. Ecological notes on the bat *Pipistrellus subflavus*. American Midland Naturalist, 68: 394–398. October.

Dozier, H. L.
1948a. A new eastern marsh-inhabiting race of raccoon. Journal of Mammalogy, 29: 286–290. August.
1948b. Color mutations in the muskrat (*Ondatra z. macrodon*) and their inheritance. Journal of Mammalogy, 29: 393–405. November.

Dozier, H. L., and H. E. Hall.
1944. Observations on the Bryant fox squirrel. Maryland Conservationist, 21: 1–12. Winter Issue.

Dozier, H. L., M. H. Markley, and L. M. Llewellyn.
1948. Muskrat investigations on the Blackwater National Wildlife Refuge, Maryland, 1941–1945. Journal of Wildlife Management, 12: 177–190. April.

Fenneman, N. M.
1938. Physiography of eastern United States. McGraw-Hill Book Co., New York and London. 714 p.

Flerov, K. K.
1952. Musk deer and deer. Fauna of the U.S.S.R. Mammals 1: 1–257 (English translation, 1960, by National Science Foundation and Smithsonian Institution).

Flyger, V. F.
1957. New record for red squirrel in Maryland. Maryland Tidewater News, March–April 1957, p. 1.
1958. The status of white-tailed deer in Maryland, 1956. Resource Study Rept., Maryland Department of Research and Education, 13: 1–9. March.
1959. Maryland's new deer citizens. Maryland Conservationist, 36: 23–24. March.

1960a. Sika deer on islands in Maryland and Virginia. Journal of Mammalogy, 41 : 140. 20 February.

1960b. Movements and home range of the gray squirrel, *Sciurus carolinensis*, in two Maryland woodlots. Ecology, 41 : 365–369. April.

Flyger, V. F., and J. Warren.

1958. Sika deer in Maryland. Additional big name animal or a possible pest. Proceedings 12th Annual Conference S E. Association Game and Fish Commission, p. 209–211.

Flyger, Vagn, and N. W. Davis.

1964. Distribution of sika deer (*Cervus nippon*) in Maryland and Virginia in 1962. Chesapeake Science, 5 : 212–213. Winter.

Gardner, M. C.

1950a. A list of Maryland mammals. Part I. Marsupials and insectivores. Proc. Biol. Soc. Washington, 63 : 65–68. 25 May.

1950b. A list of Maryland mammals. Part II. Bats. Proc. Biol. Soc. Washington, 63 : 111–114. 29 December.

Gentile, J.

1949. A case of partial albinism in the short-tailed shrew. Maryland Naturalist, 19 :11–12. Winter.

Gidley, J. W., and C. L. Gazin.

1933. New Mammalia in the Pleistocene fauna from Cumberland Cave. Journal of Mammalogy, 14 : 343–357. November.

Goldman, E. A.

1950. Raccoons of North and Middle America. North American Fauna, 60. 153 p.

Goldman, E. A., and H. H. T. Jackson.

1939. Natural History of Plummers Island, Maryland. IX. Mammals. Proc. Biol. Soc. Washington, 52 : 131–134. 11 October.

Grizzell, R. A., Jr.,

1949. Hibernating jumping mice in woodchuck dens. Journal of Mammalogy. 30 : 74–75. February.

Hall, E. R.

1951. American weasels. University Kansas Publications, Museum Natural History, 4 : 1–466. 27 December.

Hall, E. R., and K. R. Kelson.

1959. The mammals of North America. Ronald Press Co., New York. 2 vols., 1162 p. 31 March.

Hall, J. S.

1962. A life history and taxonomic study of the Indiana bat, *Myotis sodalis*. Scientific Publications Reading Museum and Art Gallery, Reading, Pa., 12 : 1–68. 30 July.

Hamilton, W. J., Jr.

1930. The food of the Soricidae. Journal of Mammalogy, 11 : 26–39. February.

1933a. The insect food of the big brown bat. Journal of Mammalogy, 14 : 155–156. May.

1933b. The weasels of New York : Their natural history and economic status. American Midland Naturalist, 14 : 289–344. July.

1935. Habits of jumping mice. American Midland Naturalist, 16 : 187–200. March.

1937. The biology of microtine cycles. Journal of Agricultural Research, Washington, 54 : 779–790. 15 May.

1938. Life history notes on the northern pine mouse. Journal of Mammalogy, 19 : 163–170. 14 May.

1940. The biology of the smokey shrew (*Sorex fumeus fumeus*). Zoologica 25: 473–492. 31 December.

1941. The food of small forest mammals in eastern United States. Journal of Mammalogy, 22: 250–263. 14 August.

1943. The mammals of eastern United States. Comstock Publishing Co., Ithaca, N.Y. 432 p.

1950. The prairie deer mouse in New York and Pennsylvania. Journal of Mammalogy, 31: 100. 21 February.

HAMLETT, G. W. D.

1938. The reproductive cycle of the coyote. U.S. Department Agriculture Tech. Bull. 616. 11 p. July.

HAMPE, I. E.

1936. The occurrence and breeding of the Maryland shrew (*Sorex fontinalis*) in the Patapsco State Park. Bulletin Natural History Society, Maryland, 7: 17–18. December. (Mimeographed)

1939. Notes on the mammals of the Patapsco State Park. Bulletin Natural History Society, Maryland, 10: 4–7. September. (Mimeographed)

1943. Mammal note. Bulletin Natural History Society Maryland, 23: 66. April, May, June.

HANDLEY, C. O., JR.

1956. The shrew *Sorex dispar* in Virginia. Journal of Mammalogy, 37: 435. August.

1959. A revision of American bats of the genera Euderma and Plecotus. Proceedings U.S. National Museum, 110: 95–246. 3 September.

HANDLEY, C. O., JR., and C. P. PATTON.

1947. Wild mammals of Virginia. Commonwealth of Virginia Commission Game and Inland Fisheries, Richmond. 220 p.

HARDY, J. D., JR.

1950. What is happening to the muskrat. Maryland Conservationist, 27: 8–9. 27. Fall.

HARRIS, V. T.

1952. Muskrats on tidal marshes of Dorchester County. Chesapeake Biological Laboratory, Solomons, Md., Publication 91. 36 p.

1953. Ecological relationships of meadow voles and rice rats in tidal marshes. Journal of Mammalogy, 34: 479–487. November.

1956. The nutria as a wild fur mammal in Louisiana. Trans. Twenty-first North American Wild. Conference, p. 424–475.

HARTMAN, C. G.

1952. Possums. University of Texas Press, Austin. 174 p.

HERMAN, C. M., P. M. BAUMAN, and R. T. HABERMAN.

1957. The presence of *Eurytrema procyonis* Denton (Trematoda: Dicrocoeliidae) in some mammals from Maryland. Journal Parasitology 43: 113–114. February.

HERMAN, C. M., and J. R. REILLY.

1955. Skin tumors on squirrels. Journal of Wildlife Management, 19: 402–403. July.

HERMAN, C. M., and O. WARBACH.

1956. Incidence of Shope's rabbit fibroma in cottontails at the Patuxent Research Refuge. Journal of Wildlife Management, 20: 85–89. January.

HINTON, M. A. C.

1931. Rats and mice as enemies of mankind. British Museum (Natural History) Economic Series No. 8. 70 p.

HOLLISTER, N.
1911. A systematic synopsis of the muskrats. North American Fauna 32. 47 p. 29 April.
HOOPER, E. T.
1942. The water shrew (*Sorex palustris*) of the southern Allegheny Mountains. Occas. Papers Museum Zoology University of Michigan, 463: 1–4. 15 September.
HOSLEY, N. W.
1956. Management of the white-tailed deer in its environment, pp. 187–259 *in* The deer of North America. Stackpole Co., Harrisburg, Pa., and Wildlife Management Institute, Washington, D.C.
HOWARD, W. E.
1949. A means to distinguish skulls of coyotes and domestic dogs. Journal of Mammalogy, 30: 169–171. May.
HOWELL, A. H.
1908. Notes on diurnal migrations of bats. Proc. Biol. Soc. Washington, 21: 35–38. 23 January.
1914. Revision of the American harvest mice. North American Fauna 36. 97 p. 14 June.
1925. Preliminary descriptions of five new chipmunks from North America. Journal of Mammalogy, 6: 51–54. February.
1929. Revision of the American Chipmunks (genera *Tamias* and *Eutamias*). North American Fauna 62. 157 p. 30 November.
1940. A new race of the harvest mouse (*Reithrodontomys*) from Virginia. Journal of Mammalogy, 21: 346. 14 August.
JACKSON, H. H. T.
1915. A review of the American moles. North American Fauna 38. 100 p. 30 September.
1922. A coyote in Maryland. Journal of Mammalogy, 3: 186–187. August.
1928. A taxonomic review of the American long-tailed shrews (genera *Sorex* and *Microsorex*). North American Fauna 51. 238 p. 24 July.
1961. Mammals of Wisconsin. University of Wisconsin Press, Madison.
JONES, J. K., Jr., and J. S. FINDLEY.
1954. Geographic distribution of the short-tailed shrew, Blarina brevicauda, in the Great Plains. Transactions Kansas Academy of Science, 57: 208–211. 2 August.
KELLOGG, R.
1937. Annotated list of West Virginia mammals. Proceedings U.S. National Museum, 84: 443–479. 7 October.
1939. Annotated list of Tennessee mammals. Proceedings U.S. National Museum, 86: 245–303. 14 February.
1956. What and where are the whitetails? p. 31–55 *in* The deer of North America. Stackpole Co., Harrisburg, Pa., and Wildlife Management Institute, Washington, D.C.
KILHAM, L.
1954. Cow-pasture nests of *Cryptotis parva parva*. Journal of Mammalogy, 35: 252. May.
KILHAM, L., and C. M. HERMAN.
1955. Severe infestation of blow flies in a raccoon. Journal of Wildlife Management, 19: 499. October.
KIRKWOOD, F. C.
1931. Swimming of the muskrat. Journal of Mammalogy, 12: 317–318. August.

336–897 O—69——13

Kolb, C. H.
1938. Mammals from the Loch Raven area. Bulletin Natural History Society, Maryland, 9: 1–5. September.

Krutzsch, P. H.
1954. North American jumping mice (genus *Zapus*). University Kansas Publication Museum Natural History, 7: 349–472. 21 April.

Lamore, D.
1953. Common skunk has meal of yellow jackets. Maryland Naturalist, 23: 80.

Latham, R. M., and C. R. Studholme.
1947. Spotted skunk in Pennsylvania. Journal of Mammalogy, 28: 409. 26 November.

Layne, J. N.
1955. Seminole bat, *Lasiurus seminolus*, in central New York. Journal of Mammalogy, 36: 453. August.

LeCompte, E. L.
1937. Otter caught in gill net. Maryland Conservationist, 14: 15. Summer Issue.
1942. Analysis of game kill statistics for season of 1941. Maryland Conservationist, 19: 4–5, 8.

Lewis, J. B.
1940. Mammals of Amelia County, Virginia. Journal of Mammalogy, 21: 422–428. 14 November.

Liers, E. E.
1951. Notes on the river otter (*Lutra canadensis*). Journal of Mammalogy, 32: 1–9. 15 February.

Llewellyn, L. M., and F. H. Dale.
1964. Notes on the ecology of the opossum in Maryland. Journal of Mammalogy, 45: 113–122. February.

Llewellyn, L. M., and C. O. Handley.
1945. The cottontail rabbits of Virginia. Journal of Mammalogy, 26: 379–390. February.

Llewellyn, L. M., and F. M. Uhler.
1952. The foods of fur animals of the Patuxent Research Refuge, Maryland. American Midland Naturalist, 48: 193–203. July.

Long, C. A.
1963. Mathematical formulas expressing faunal resemblance. Transactions Kansas Academy of Science, 66: 138–140.

Mansueti, R.
1941. Trouessart's little brown bat around Baltimore. Bulletin Natural History Society Maryland, 11: 56–57. January–February.
1950. Extinct and vanishing mammals of Maryland and District of Columbia. Maryland Naturalist, 20: 1–48. Winter-Spring.
1952. Comments on the fox squirrels of Maryland. Maryland Naturalist, 22: 30–41.
1953. The varying hare, or snowshoe rabbit, in Maryland. Maryland Naturalist, 23: 71–75.
1955. Seal strays into Maryland waters. Maryland Tidewater News, 12: (3) 1. August.
1958. The Cranesville Pine Swamp. Atlantic Naturalist, 13: 72–84. April-June.

Mansueti, R., and V. F. Flyger.
1952. Longtailed shrew (*Sorex dispar*) in Maryland. Journal of Mammalogy, 33: 250. May.

MANVILLE, R. H., and R. P. SHANAHAN.
1961. *Kogia* stranded in Maryland. Journal of Mammalogy, 42: 269–270. May.
MARTIN, A. C., H. S. ZIM, and A. L. NELSON.
1951. American wildlife and plants. McGraw-Hill Book Co., New York. 500 p.
MARYE, W. B.
1945. Some extinct wild animals of Tidewater. Maryland Tidewater. News, 2: 1–3.
MAYNARD, C. J.
1889. Singular effects produced by the bite of a short-tailed shrew, *Blarina brevicauda*. Contributions to Science, 1: 57–59. July.
MCATEE, W. L.
1918. A sketch of the natural history of the District of Columbia. Bulletin Biological Society Washington, 1: 3–142. May.
MCKEEVER, S., et al.
1952. A survey of West Virginia mammals. Conservation Commission, West Virginia Pittman-Robertson Project 22–R. 126 p. 4 January. (Mimeographed)
MERRIAM, C. H.
1887. Do any Canadian bats migrate? Evidence in the affirmative. Transactions Royal Society of Canada, Section 4: 85–87.
1895. Revision of the shrews of the American genera *Blarina* and *Notiosorex*. North American Fauna 10. 125 p. 31 December.
MILLER, G. S., Jr.
1897. Revision of the North American bats of the family Vespertilionidae. North American Fauna 13. 140 p. 16 October.
1912. Catalogue of the mammals of western Europe. British Museum (Natural History). 1019 p.
1924. List of North American Recent mammals, 1923. Bulletin U.S. National Museum, 128. 673 p.
MILLER, G. S., Jr., and R. KELLOGG.
1955. List of North American Recent mammals. Bulletin U.S. National Museum 205. 954 p. 3 March.
MITCHELL, A. L.
1934. Eastern extension of the range of *Peromyscus maniculatus bairdii*. Journal of Mammalogy, 15: 71. February.
MOULTHROP, P. N.
1938. The pairie white-footed mouse in New York State. Journal of Mammalogy, 19: 503. 14 November.
NELSON, E. W.
1909. The rabbits of North America. North American Fauna 29. 314 p. 31 August.
OSGOOD, W. H.
1909. Revision of the mice of the American genus *Peromyscus*. North American Fauna 28. 285 p. 17 April.
PATTON, C. P.
1939. Distribution notes on certain Virginia mammals. Journal of Mammalogy, 20: 75–77. February.
PEACOCK, D., and R. PEACOCK.
1962. *Peromyscus maniculatus bairdii* in Virginia. Journal of Mammalogy, 43: 98. February.
PEARSON, O. P.
1942. On the cause and nature of a poisonous action by the bite of a shrew (*Blarina brevicauda*). Journal of Mammalogy, 23: 159–166. May.

Pearson, O. P., M. R. Koford, and A. K. Pearson.
1952. Reproduction of the lump-nosed bat (*Corynorhynus rafinesquei*) in California. Journal of Mammalogy, 33: 273–320. August.

Poole, A. J., and Viola S. Schantz.
1942. Catalog of the type specimens of mammals in the United States National Museum, including the Biological Surveys collection. Bulletin U.S. National Museum 178: 705 p. 9 April.

Poole, E. L.
1932. *Lasiurus seminolus* in Pennsylvania. Journal of Mammalogy, 13: 162. May.
1937. Pennsylvania records of *Sorex cinereus fontinalis*. Journal of Mammalogy, 18: 96. 14 February.
1943. *Synaptomys cooperi stonei* from Eastern Shore of Maryland. Journal of Mammalogy, 24: 103. 20 February.

Preble, E. A.
1899. Revision of the jumping mice of the genus *Zapus*. North American Fauna 15: 42 p. 8 August.

Presnal, C. C.
1958. The present status of exotic mammals in the United States. Journal of Wildlife Management, 22: 45–50. January.

Quimby, D. C.
1951. The life history and ecology of the jumping mouse, *Zapus hudsonius*. Ecological Monographs, Durham, 21: 61–95. January.

Rhoads, S. N.
1903. The mammals of Pennsylvania and New Jersey. Privately published. Philadelphia. 266 p. After 11 April.

Schwartz, F. J.
1962. Summer occurrence of an immature little piked whale, *Balaenoptera acutorostrata*, in Chesapeake Bay, Maryland. Chesapeake Science 3: 206–209. September.

Schwarz, E., and Henriette K. Schwarz.
1943. The wild and commensal stocks of the house mouse, *Mus musculus* Linnaeus. Journal of Mammalogy, 24: 59–72. 20 February.

Seibert, Henri
1939. Weasel. Bulletin Natural History Society of Maryland, 10(1): 21, September.

Severinghaus, C. W., and E. L. Cheatum
1956. Life and times of the white-tailed deer, pp. 57–186 *in* The deer of North America. Stackpole Co., Harrisburg, Pa., and Wildlife Management Institute, Washington, D.C.

Sheffer, D. E.
1957. Cottontail rabbit propagation in small breeding pens. Journal of Wildlife Management, 21: 90. January.

Shreve, F., M. A. Chrysler, F. H. Blodgett, and F. W. Besley.
1910. The plant life of Maryland. Maryland Weather Service. Baltimore, Johns Hopkins Press, 1910, v. 3. 533 p.

Silver, James
1928. Pilot black snake feeding on big brown bat. Journal of Mammalogy, 9: 149, May.

Smith, F. R.
1938. Muskrat investigations in Dorchester County, Maryland, 1930–1934. U.S. Department of Agriculture Circular 474. 24 p. May.

Sollberger, D. E.
1940. Notes on the life history of the small eastern flying squirrel. Journal of Mammalogy, 21 : 282–293. 14 August.
1943. Notes on the breeding habits of the eastern flying squirrel (*Glaucomys volans volans*). Journal of Mammalogy, 24 : 163–173. May.
Sperry, C. C.
1941. Food habits of the coyote. U.S. Department of the Interior, Wildlife Research Bulletin 4. 70 p.
Stewart, R. E., and C. S. Robbins.
1958. Birds of Maryland and the District of Columbia. North American Fauna 62. 401 p.
Stickel, Lucille F.
1946. The souce of animals moving into a depopulated area. Journal of Mammalogy, 27 : 301–307. 25 November.
1948. Observations on the effect of flood on animals. Ecology 29: 505–506. October.
Stickel, W. H.
1951. Occurrence and identification of the prairie deer-mouse in central Maryland. Proc. Biol. Soc. Washington, 64 : 25–32. 13 April.
Tate, G. H. H.
1947. Mammals of eastern Asia. Macmillan Co., New York. 366 p.
Tromba, F. G.
1954. Some parasites of the hoary bat *Lasiurus cinereus* (Beauvois). Journal of Mammalogy, 35 : 253–254. May.
True, F. W.
1890. Observations on the life history of the bottlenose porpoise. Proceedings U.S. National Museum, 13 : 197–203.
Uhler, F. M., and L. M. Llewellyn
1952. Fur productivity of submarginal farmland. Journal of Wildlife Management, 16 : 79–86. January.
Van Gelder, R. G.
1959. A taxonomic revision of the spotted skunks (genus *Spilogale*). Bulletin American Museum Natural History, 117 : 229–392. 15 June.
Vázquez, A. W.
1956. A new southern record for *Mustela erminea cicognanii*. Journal of Mammalogy, 37 : 113–114. February.
Wetmore, A.
1923. The wood rat in Maryland. Journal of Mammalogy, 4 : 187–188. August.
Wetzel, R. M.
1955. Speciation and disperal of the southern bog lemming, *Synaptomys cooperi* (Baird). Journal of Mammalogy, 36 : 1–20. February.
Young, S. P., and H. H. T. Jackson.
1951. The clever coyote. Stackpole Co., Harrisburg, Pa., and Wildlife Management Institute, Washington, D.C. 411 p.

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